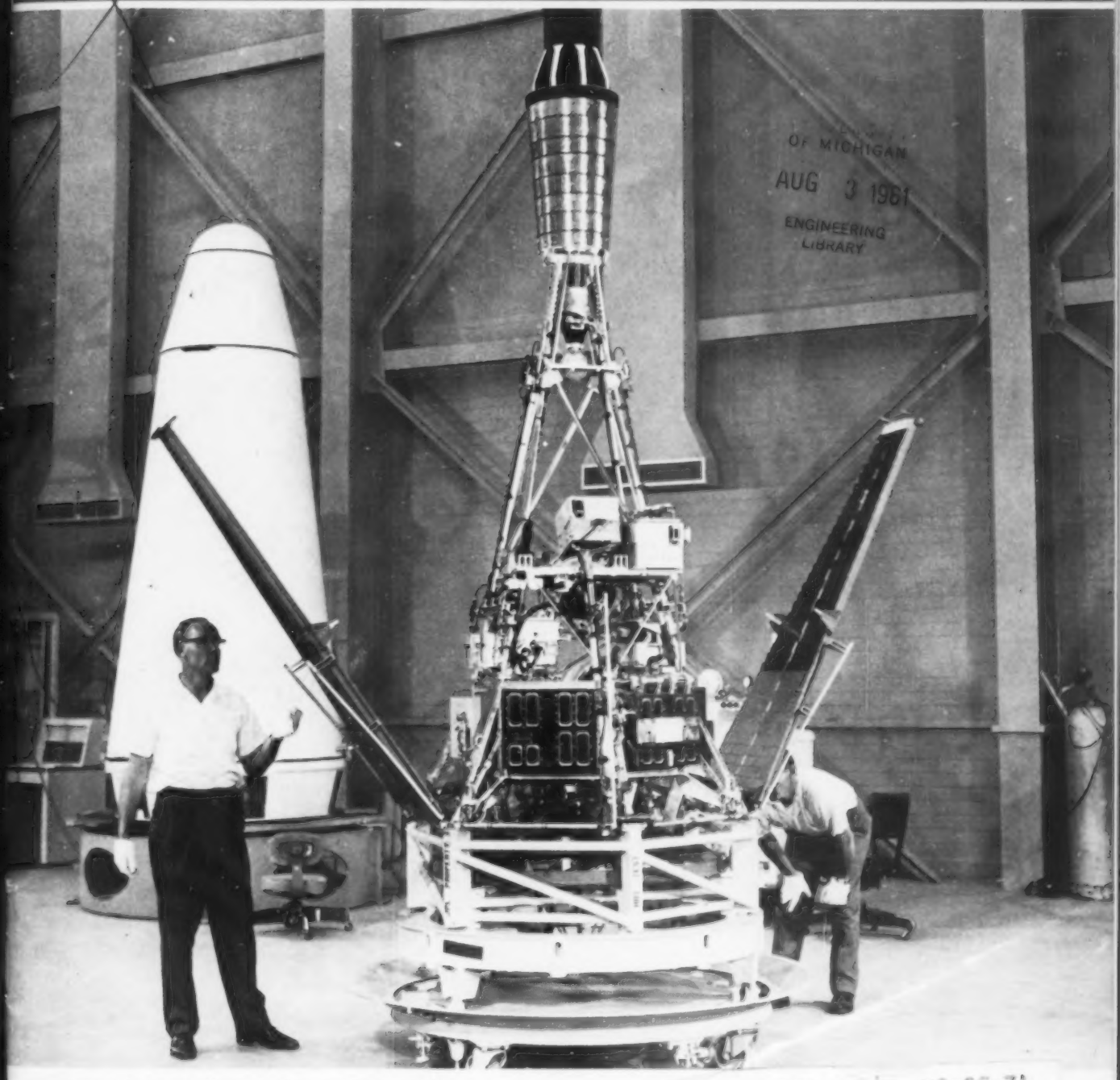
JULY 31, 1961

missiles and rockets

THE MISSILE/SPACE WEEKLY



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First Photo of Ranger Lunar Spacecraft

Kennedy Ups the Tactical Missile Ante . .

Ranger to Advance U.S. Space Frontiers .

Door Opens to 'Low Temp' Thermionics . . .

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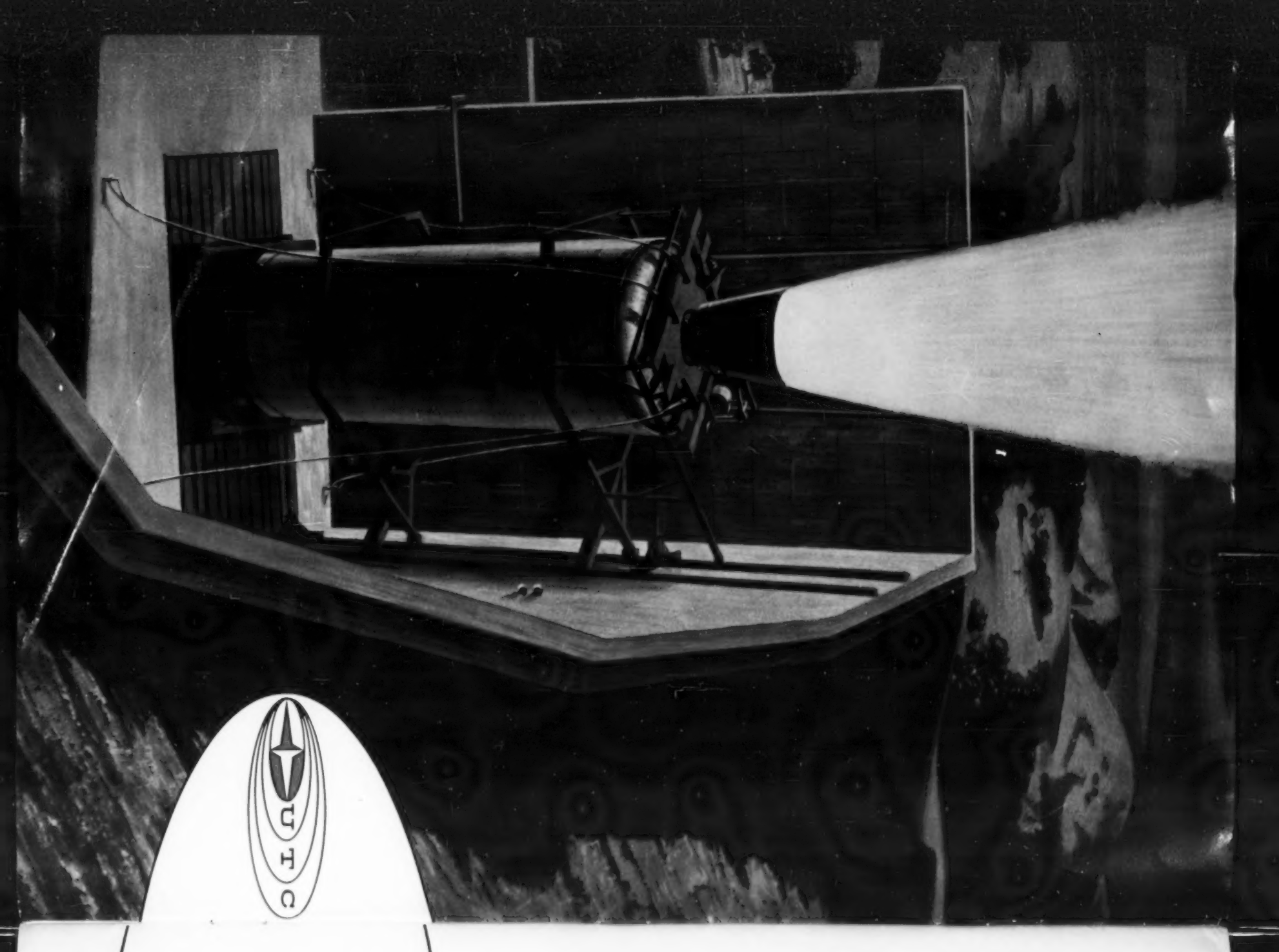

"...firm commitment to a new course of action..."*

Current achievements by the rocket propulsion industry give reassuring evidence of this nation's ability to seize the initiative in the development of large solid propellant boosters. This has special significance in the light of President Kennedy's appeal "for this nation to take a clearly leading role in space achievement."*

Now the industry looks forward to the next significant advance—firing of flight-weight segmented solid propellant rockets of 250,000 and 500,000 pounds thrust at UTC's Development Center.

Capability backed by four decades of propulsion experience

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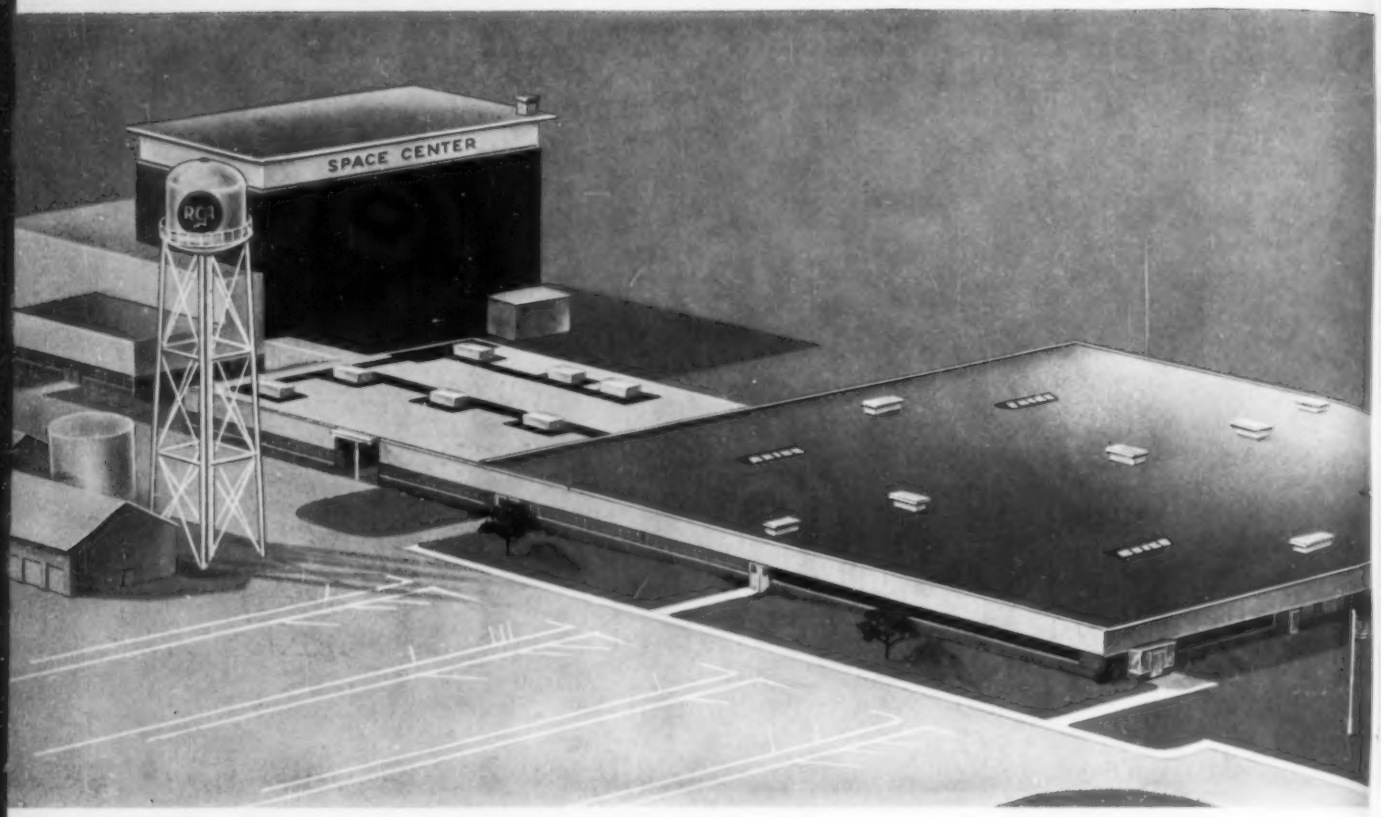
**Excerpts from the special message delivered by President Kennedy before a joint session of Congress, May 25, 1961.*

New RCA Space Environment Facility Brings Outer Space Down to Earth...



... Will pretest coming generations of U.S. space vehicles and satellites at environmental extremes assuring reliable long life operation and optimum performance.

Included in the new environmental equipment and facilities being built and installed at the RCA Astro-Electronics Division at Princeton, N.J., are the following advanced testing devices:

Vacuum-Thermal Chamber — measuring 28 feet in diameter and 25 feet high to accommodate the coming generations of space vehicles and satellites and meet all vacuum-thermal requirements.

Vibration System — provides 28,000 pounds peak force for sinusoidal, and 28,000-pound rms force for random motion testing.

Temperature-Humidity Chamber — so versatile it can create virtually any thermal-humidity condition desired. Temperatures may be varied from —85° F to 250° F; humidity from nil to maximum.

Rotary Accelerator — subjects subsystems of space vehicles and satellites to forces as high as 2500 g lbs.

The entire RCA Space Center, which contributed to the success of projects such as SCORE, TIROS I, TIROS II and ECHO I, continues to be dedicated to the conception, development and production of earth satellites, space vehicles and ground support and information handling equipment. For additional information about RCA's engineering talents and proved capabilities, contact the Manager, Marketing, RCA Space Center, Box 800, Princeton, N. J. And, for a complete description of the new environmental facilities, write for your copy of the brochure "RCA Space Environment Center."

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THE MISSILE / SPACE WEEKLY

missiles and rockets

Volume 9, Number 5 July 31, 1961

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THE COVER

First photo of NASA's Ranger lunar impact spacecraft shows JPL technicians monitoring unfolding of solar panels. First launch was scheduled for last week. See p. 14.

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† U.S. Reg. Pdg.

35,375 copies this issue

SUPPORT FOR THE SPACE AGE

Since the early days of "wireless" Blaw-Knox has been designing, fabricating and erecting towers and special structures to support equipment used to penetrate space. This long experience with the problems involved in this field is the reason systems companies and governmental agencies continue to utilize Blaw-Knox specialized facilities.

Call Blaw-Knox early in the planning stages for consultation and assistance on the design and fabrication of either prototype or production items. Blaw-Knox Company, Pittsburgh 38, Pennsylvania.

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letters

Someone Should Investigate

To the Editor:

This letter is in reference to Mr. (George W.) Earley's Letter to the Editor (M/R, July 17, p. 9) under the heading "UFO's Will Rise Again." I took the trouble to scan the back issues of MISSILES AND ROCKETS to find the previous (M/R, March 27, p. 6) correspondence between you and Mr. Earley. It would have been a simple job had you indicated in which issue Mr. Earley's first letter appeared. Briefly, the first letter asks M/R to investigate the accusation that the USAF is withholding information concerning UFO's. The National Investigations Committee on Aerial Phenomena (NICAP) is recommended as a convenient source of information. Your comment: "What else is new in Bloomfield?" I don't know if this is supposed to be humorous, derisive, or what? Anyway, Mr. Earley, in his second letter, raised the question as to your sincerity in wanting the American people to be thoroughly informed. Your handling of this question certainly nourishes his and my doubts on the issue. NICAP has in its possession numerous UFO reports given by highly qualified observers, which when reviewed provide a convincing argument for existence of UFO's. I believe the matter is serious enough to warrant an investigation.

Nicholas Conigliaro
Hazlet, N. J.

M/R is a trade journal of the missile/space industry. Our working time and pages are necessarily devoted to covering the multitude of known, factual events and trends in that industry. We take no sides in the UFO debate; we just don't have time for it.—Ed.

Ski-Launches and Patents

To the Editor:

Two subjects:

(1) On May 29, before (syndicated columnist) Ralph McGill reported the ski-slide launching system for Russian missiles, I wrote to your editorial department suggesting that you get and publish full details on the French report which was the subject to McGill's column. I feel that most of your subscribers, like myself, were keenly interested, and disappointed also when issue after issue of M/R came out minus any word on that reported launching system. You could at least have denied the truth of that report if it were false, or acknowledged my letter.

(2) Your July 24 editorial relative to patent rights on inventions flowing out of U.S. R&D contracts:

If you regularly read *Electronics*, you may have seen my letter commenting on this subject, also some further comments by others.

The crux of this doubletalk by our large R&D contractors is that they themselves do not practice what they preach. When *they* hire scientists and engineers they demand and get employment contracts which give *them* all of the inventions of these employees in which they have the slightest present or possible future interest.

But, when these same R&D contractors are hired by the government they demand, unjustifiably, the outcoming patent rights! And you, as does McGraw-Hill, loyally support the sources of *your* revenue!

I'd like you to *print* this, please.

Benjamin F. Miessner
Fellow IRE and ASA
Miami Shores, Fla.

(1) For more than a year there have been rumors that the Russians have been launching missiles from carriages traveling rails laid down one mountain slope into a valley and up a second mountain slope. According to these reports, the booster ignites when the carriage nears the end of the track and the missile goes into its trajectory greatly assisted by the momentum gained during its "rollercoaster" trip. M/R has not published these rumors (nor, we believe, has any other technical publication) because of the obvious technical objections to any such launching technique. Perhaps the most apparent flaw would be the sloshing problem; sloshing poses difficulties even in vertical launchings —in any such angled take-off they would be fantastic.

(2) The editorial concerned private *developments by missile/space firms. Inventions by employees on company time would hardly seem analogous.—Ed.*

Appreciated

To the Editor

We have an active interest in educating the youth of our community in space technology through our Speakers Bureau activities, and have been aided in many ways by utilizing the information contained in M/R's Astrolog.

I have also reviewed your World Missile/Space Encyclopedia (M/R, July 17) and find this information very useful.

Thank you for such a fine publication.

R. A. Scheffer
Senior Engineer
Electrical Space Propulsion
General Electric Co.
Cincinnati

Redstone Interest

To the Editor:

"Redstone's Years of Frustration" by James Baar (M/R, May 15, p. 17) is a very fine article that is of interest to all in the *Redstone* program.

John R. Riordan
Major, Artillery
Chief
U. S. Army Artillery and Missile School
Guided Missile Department
Redstone Division
Fort Sill, Okla.

—mergers & expansions—

LABORATORY FOR ELECTRONICS, INC., and Tracerlabs, Inc., boards of directors have voted to merge the two companies, pending stockholder approval. Laboratory for Electronics will be the surviving company. LFE is a producer of airborne navigation and radar systems, microwave test instruments, data storage, and display equipment. The combined companies will have sales of over $60 million.

UNITED RESEARCH INCORPORATED and Broadview Research Corp. have merged, with BRC now a wholly owned subsidiary of URI. The parent company performs R&D in physical sciences, management sciences and data processing.

ASTROPOWER, INC., is planning to build an R&D center at Costa Mesa, Calif., to house engineering, laboratory and administration facilities. Occupancy is scheduled for next May. The company will also build a rocket propulsion test site at Gypsum Canyon, Calif., to test small-scale propulsion units and other space vehicle systems. The facility is expected to be operational in August.

COLLINS RADIO CO's Western Operation has moved into a multi-million-dollar communication and data processing R&D facility at Newport Beach, Calif. Among the Information Science Center's projects are data transmission systems for both the Atlantic and Pacific Missile Ranges.

HEWLETT-PACKARD CO. is expanding its European operations with construction of a new plant in Western Germany and the leasing of a manufacturing facility in England. The British facility will be operated by Hewlett-Packard Ltd., a newly formed subsidiary. The German plant will be located near Stuttgart. H-P produces precision instruments and accessory devices.

ALLIED CHEMICAL CORPORATION, Nitrogen Div., announced plans for a plant to double its nitrogen tetroxide capacity. A facility for producing the rocket fuel oxidizer is being built at Hopewell, Va., and the company expects delivers to begin in late August.

PALL CORPORATION, Glen Cove, N.Y., has merged with Trinity Equipment Corp., a producer of dry air and gas systems, thermowells and thermocouples. Trinity will continue as a wholly owned subsidiary of Pall.

CALLERY PROPELLANT BRIEFS

Let's talk impulse in space

Exotic chemical propellants will often find their most useful applications in upper stages, for course or orbit correction and lunar landing or take-off. Isp values compared at $P_E = 0.2$ psia have a different relationship than when compared at $P_E = 14.7$ psia. Such an approximation of "space" conditions gives a much truer picture of the relative performance of propellant systems. We present (from Callery's new booklet — Propellant Performance Data*) a few excerpts to illustrate the point. As the U. S. standardizes on LOX-RP, LOX-LH_2, and solids, there is still considerable merit in storable liquid systems for specialized jobs in space.

PROPELLANT SYSTEM	SPECIFIC IMPULSE	
	Sea Level 1000→14.7	Space 1000→0.2
H_2–O_2	391	470
B_5H_9–OF_2	367	466
B_5H_9–F_2	360	460
N_2H_4–F_2	363	436
B_5H_9–O_2	327	421
B_5H_9–NF_3	326	412
B_5H_9–H_2O_2	316	405
B_5H_9–N_2O_4	306	391
B_5H_9–ClO_3F	306	390
RP–O_2	300	379
B_5H_9–ClF_3	290	368
N_2H_4–N_2O_4	291	354
CH_2–NO_2ClO_4	278	349

*Available upon letterhead request from:

Callery Chemical Company, Defense Products Department

Headquarters: Callery, Pennsylvania, Telephone Evans City (Pa.) 3510
West Coast: 15537 Lanark Street, Van Nuys, California, Telephone STate 1-5761
Washington, D.C.: 709 DuPont Circle Building, Telephone ADams 4-4200
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missiles and rockets
4th Annual

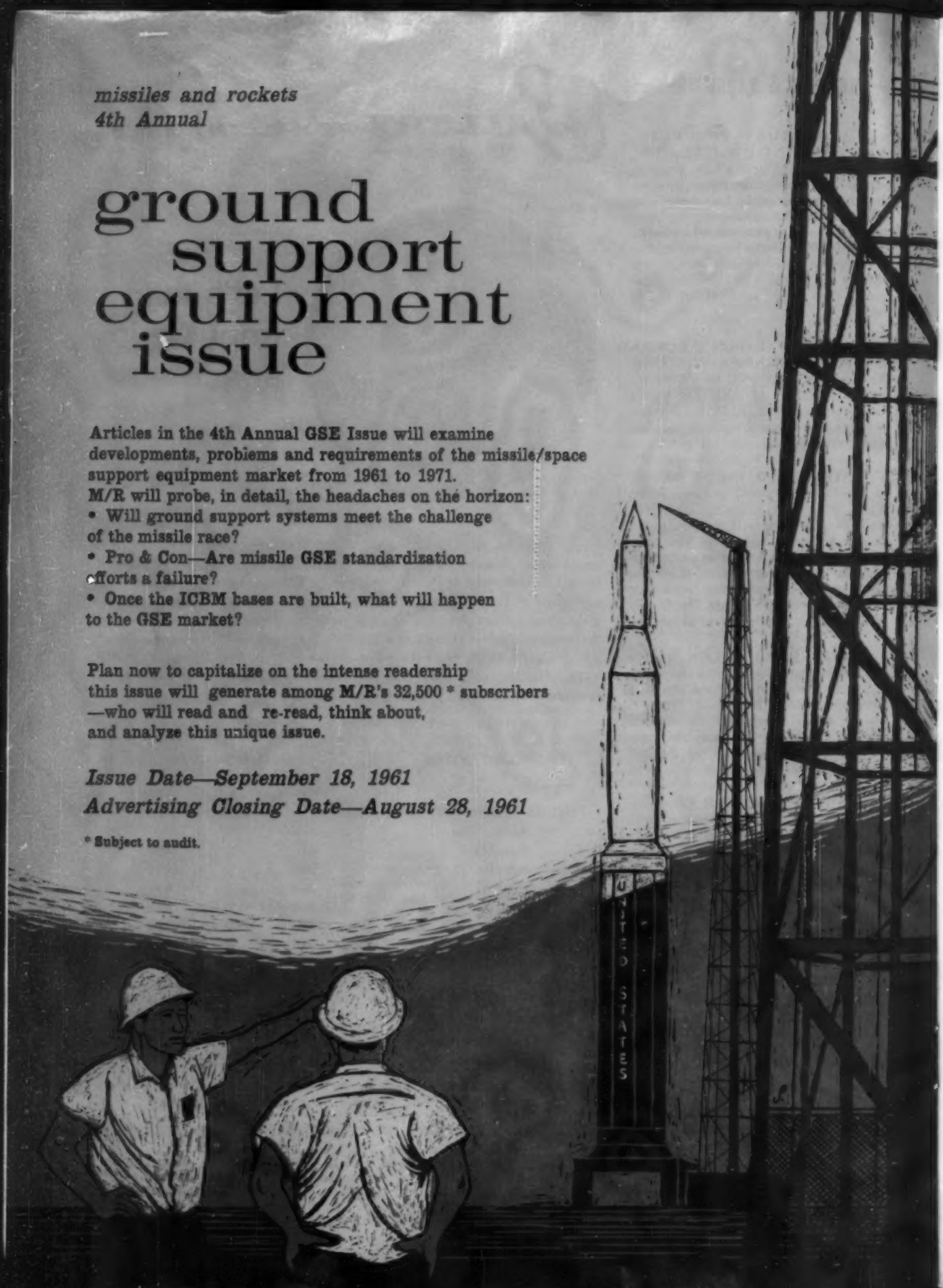
ground support equipment issue

Articles in the 4th Annual GSE Issue will examine developments, problems and requirements of the missile/space support equipment market from 1961 to 1971.
M/R will probe, in detail, the headaches on the horizon:
- **Will ground support systems meet the challenge of the missile race?**
- **Pro & Con—Are missile GSE standardization efforts a failure?**
- **Once the ICBM bases are built, what will happen to the GSE market?**

Plan now to capitalize on the intense readership this issue will generate among M/R's 32,500 * subscribers —who will read and re-read, think about, and analyze this unique issue.

Issue Date—September 18, 1961
Advertising Closing Date—August 28, 1961

*** Subject to audit.**



The Countdown

WASHINGTON

On Spending Defense Rubles

Government experts are watching for signs that Russia will carry out Khrushchev's announced increase in Soviet military spending. When translated into purchasing power and hidden expenses, the boost runs from $8-$15 billion, depending on which expert's figures are used. If Russia is to spend this kind of extra money on defense, sharp changes in the Soviet economy are in order.

Unhappy Congressmen in Space

Despite easy passage of the re-revised $1.7-billion NASA authorization bill, a number of influential congressmen are uneasy about the nation's man-to-the-moon program. The general complaint: because of the complexity of space technology, many congressmen feel that they have to accept from the Administration's experts what they are told—even when what they are told varies from month to month.

Doubt Cast on Red Polaris Claim

Navy officials are giving little credence to Soviet claims that they possess a larger number of nuclear-powered submarines capable of launching *Polaris*-type missiles than does the United States. However, it is considered quite possible that the Soviet Union does have in operation a number of nuclear-powered submarines capable of launching relatively short-range missiles.

Wanted: Tactical Nuclear Missiles

Even with President Kennedy's call for more conventional forces, a number of Army strategists feel that the Berlin crisis underlines the need for large numbers of small, sub-kiloton-warhead missiles. HE warheads on tactical missiles will have a hard time stopping the Red Horde. But implicit in the argument for better tactical nuclear warheads is the need to resume testing them underground—as many officials feel the Russians already have done.

Coming: The Standardized Warship?

Pressure is on in the Navy—beginning with Secretary John Connally—for far greater standardization of warships and their equipment. Navy officials are arguing that it is better to have a lot of one good model than just a few of several different models. For example: A missile frigate in FY 1959 was estimated to cost $48.7 million; a missile frigate in FY 1961 was estimated to cost $71 million.

Mercury Check and Double Check

Tough orders have gone out from NASA to Cape Canaveral technicians for the most minute checkout to date of the *Atlas* that will attempt to hurl a *Mercury* capsule into orbit this September. Two out of three *Atlas* launchings in the *Mercury* program have failed in the past. Another failure in September would be certain to push the first attempt to orbit a manned capsule far into next year.

INDUSTRY

Jobs . . . Jobs . . . Jobs

NASA soon expects to have 135 top job openings for scientists and executives. Seventeen of the jobs will pay up to $21,000 a year . . . the rest up to $19,000. NASA officials say some of the new posts will be filled from within the agency, but most will be filled from industry. The Manned Space Flight Group has 78 of the openings —28 will be in existing programs; 10 will be in advanced research; 10 in nuclear propulsion work; 10 in NASA headquarters.

DOD Will Be Watching

The Pentagon is putting together performance charts on contractors, for use in making future contract awards. The charts will reflect a wide variety of factors from meeting major milestones to undercutting minor cost estimates.

Sea-Launch Revived

The House Space Committee will take another look at proposals for mobile sea-launch facilities for large rocket boosters. Although it issued a report after hearings earlier this year which said there was no urgent need for such facilities, the committee now has decided to hold additional hearings—apparently to see what sea-launch could do to expedite the lunar program.

INTERNATIONAL

Sweden Eyes Satellite

Sweden's Committee for Space Research is proposing an air-launched satellite weighing 10 lbs. A Saab Draken fighter would carry a three-stage rocket to altitude, which would then fire the satellite into a 1000-mile polar orbit. So far, however, there's no sign the committee will receive the $15 million needed for the project.

Vulcan-Skybolt Compatibility

Douglas *Skybolt* ALBM's reportedly have passed electromagnetic compatibility tests with British Vulcan bombers. A problem of matching *Skybolt's* electronic gear to the Vulcan's navigation system appears to have been solved.

Overseas Pipeline

About 70 Sud Aviation *SE 4280* tactical missiles are now operational with the French Army. . . . Elliott-Automation Ltd. and C. A. Parsons & Co. Ltd. have joined the British Space Development Co.—making a total of 11 firms now in the space research enterprise. . . . France's Military Mission has been in contact recently with The Martin Co., discussing possible purchase of the 400-mile *Pershing*.

The Missile/Space Week

Shots of the Week

The Army successfully fired its *Pershing* missile from Cape Canaveral July 19. ABMA reported that preliminary data indicated all test objectives were achieved. Exact distance was not disclosed, but an ABMA official said the missile exceeded the maximum range of the *Redstone*, which *Pershing* will replace.

A *Discoverer* satellite, the 27th in the series, was destroyed by the range safety officer 60 seconds after launching from Vandenberg AFB July 21. Air Force officials had no immediate explanation for the failure.

A Canaveral-launched *Titan* went 5000 miles down the Atlantic Missile Range July 25, guided for the first time by "Achiever." The guidance system is a self-contained inertial package containing a 90-lb. computer, with a 57-track magnetic memory drum.

Fly-by Speed-up Studied

The launching of a Mars "fly-by" may be updated two years, from 1964 to late '62.

The National Aeronautics and Space Administration is studying whether it is too late to reschedule the Mars probe, planned originally for 1962 but delayed for 25 months because of budget restrictions. Budget curbs have now been lifted and if it is possible to update launch time, House Space Committee Chairman Overton Brooks considers it a chance to reclaim some of the prestige lost when Russia put the first man into space.

Tiros III Loses One Camera

One of the television cameras aboard *Tiros III* has gone out of action, but a duplicate is still taking high-quality cloud cover pictures.

NASA said the failure was detected July 24, after the 170th orbit and after the camera had taken 2020 "excellent quality" cloud cover pictures.

The cause of failure has not been determined and scientists do not know if it is a permanent malfunction. Since two wide-angle cameras were aboard, NASA said, the loss of one will not affect the satellite's useful lifetime.

Aerojet to Develop NERVA

Aerojet-General Corp. has been awarded a $6-million, first-phase contract for development of the nuclear rocket engine, NERVA.

The six-month contract will include design of the engine, which is being built under a joint NASA-AEC program. NERVA is the first-generation nuclear powerplant which will lift heavy payloads on interplanetary missions.

Space Environment for NASA

NASA has awarded a contract to the Minneapolis-Honeywell Regulator Co. for design and engineering services of a space environment facility.

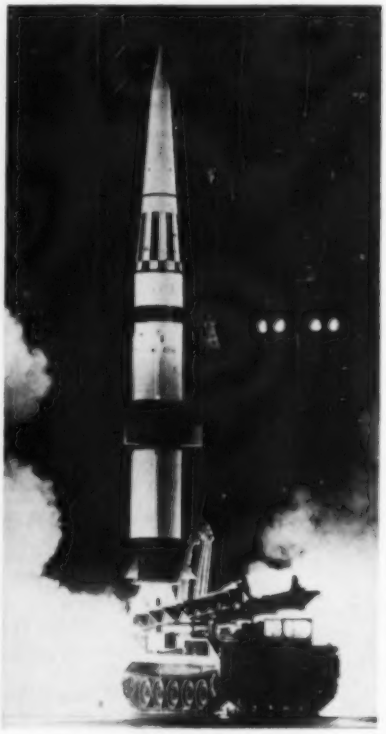
The laboratory will be built at Greenbelt, Md., and will be used to check out and test large spacecraft.

The firm was one of seven industrial companies which submitted bids.

Two space chambers—among the largest to be constructed in the nation—will measure 35 ft. in diameter and 52 ft. high. Working dimensions internally will be 30 ft. by 40 ft.

The chambers are due to be in operation on Oct. 31, 1962.

A dynamic test chamber will test mechanical actions—dynamic balancing, spinup tests, and solar paddle erection—which normally occur under near-vacuum conditions and which cannot properly be simulated under ground atmosphere conditions.



Successful Pershing

ALL TEST AIMS were achieved in recent test firing of the Army's Pershing missile from Cape Canaveral. Objectives included further evaluation of the missile's self-contained inertial guidance system and high-performance rocket motors.

Yuri's Cuban 'Dream'

A driving rain and a large crowd greeted Yuri Gagarin on his arrival in Havana to help celebrate the eighth anniversary of Fidel Castro's revolution.

The Soviet astronaut received a hero's welcome and told the Cuban people he was "very happy that my old and cherished dream is at last coming true—to visit heroic Cuba."

NASA Gets Extra Funds

President Kennedy signed NASA's Fiscal 1962 appropriations bill providing a total of $1,784,300,000.

He had asked Congress for extra money on May 25, when he committed the U.S. to a "leading role in space achievement" and to putting a man on the moon by 1970. Kennedy signed the bill several hours after watching the sub-orbital shot of Astronaut Virgil Grissom.

Commission Cracks Down

The Missile Sites Labor Commission handed down its first decision since being formed in May by President Kennedy.

The case involved a jurisdictional dispute between Evans Construction Co. and International Telephone &

Telegraph Corp. over work assignments in the installation of underground cable at Walker AFB, N.M., missile site. There was no work stoppage and all parties complied with the decision.

Meanwhile, the Commission issued a four-page policy statement saying it would crack down on wasteful practices or overtime pay abuses by unions at missile bases and would check contracts covering construction at bases to try to end "unreasonable" provisions.

Highlights:

—Wages and fringe benefits should not cost more at missile sites than at other construction activities in the same locale.

—"The Commission has directed its attention particularly to the pyramiding of premium pay, to excessive travel and subsistence allowances and to unusual premiums for various types of work operations."

—"The Commission urges the Defense Department and NASA to review the present schedules of overtime hours on bases."

—Affected parties will have an opportunity to present their views before the Commission condemns any provisions as unfair.

Minuteman Award to Hercules

A $50-million Air Force R&D contract was awarded to Hercules Powder Co. for *Minuteman* third-stage propulsion. The contract also calls for delivery of several flight-test motors for the solid rocket to Cape Canaveral.

Work will be conducted at Hercules' Bacchus, Utah, plant with support from other divisions.

Flight Records Recognized

Space flight records claimed by both the USSR's Yuri Gagarin and the U.S.'s Alan Shepard have been officially recognized by the IAF (Fédération Aeronautique Internationale), the international authority on flight records.

Gagarin: duration in orbital flight —108 minutes; greatest altitude in earth orbital flight—203 miles; greatest mass lifted in earth orbital flight —10,395 lbs.

Shepard: altitude without orbit—115.696 miles; greatest mass lifted without earth orbit—4031.7 lbs.

GOING UP
WITH
RCA TITAN
PROJECT

RCA Titan Project, Marysville, California, has a limited number of openings for experienced Missile Engineers willing to step *up* to RCA. Openings exist at all levels in these engineering areas:

- FUELING AND PROPULSION
- MECHANICAL EMPLACEMENT
- STANDARDS, SAFETY, QUALITY
- LAUNCH CONTROL AND CHECKOUT
- ELECTRO-MECHANICAL INTEGRATION

If you are a qualified Missile Engineer and would like more information about the challenge and benefits awaiting you at the RCA Titan Project: (a) circle your professional area above; (b) check the items of information desired below; (c) attach a resume of your professional accomplishments to this ad and mail today.
If you wish, feel free to send your resume or request an application from the address below.

Please send more information about:

—— Rapid advancement opportunity in my professional area circled above.
—— Ideal family living conditions in greater Marysville area.
—— Challenging RCA Service Company Titan Project.
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—— Send RCA application form.

If possible, arrange a personal interview at my convenience in:

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—— Other (Write in) ——————

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Circle No. 6 on Subscriber Service Card

Troops need weapons...

New Defense Plans Call for

Congress due to give quick approval to Kennedy request for another $3.4 billion—$357.8 million for missiles

by James Baar

THE BERLIN-PROMPTED third revision of the Kennedy defense budget is initiating a major build-up of the nation's long-neglected tactical missile arsenal.

Moreover, the $3.4-billion increase in the Administration's defense requests for FY '62 is making the need for the build-up more critical than ever before —by creating new divisions to equip.

These are but two of the significant factors involved in or expected to result from President Kennedy's dramatic call for increasing U.S. limited war forces. Others:

—Many of the increases are coming too late to have other than a psychological effect in East-West negotiations over Berlin this fall. However, the increases are expected to become a permanent part of the nation's military posture in order to cope with future Berlins.

—Congress, which is expected to act quickly and favorably on the Kennedy requests, now is also all but certain to approve some three quarters of a billion dollars extra for bomber procurement and B-70 R&D despite Administration objections.

—Congressional and military pressure is expected to mount rapidly for procurement of more long-range strategic missiles, the production of the *Nike-Zeus* anti-ICBM ICBM and a far greater increases in ASW forces, particularly in hunter-killer nuclear-powered submarines.

—The requested increases for tactical missile procurement, $357.8 million, brought to more than $12.5 billion the total Kennedy missile/space budget for FY '62. That is about 14% of the total national budget.

The new Kennedy requests fell almost equally into two major parts. He sought $1.4 billion for more troops and for operation and maintenance. He sought $1.7 billion for the procurement of military hardware. The remaining $207 million was sought for the Pentagon's new civil defense operations.

• **Missile breakdown**—The bulk of the money for missile procurement—$262 million—was sought for the Navy. The money would be used for large increases in the purchase of air-to-surface *Bullpups*, air-to-air *Sparrows* and *Sidewinders* and surface-to-air *Talos*, *Tartar* and *Terrier* missiles.

The Navy also would receive an unspecified amount for sizeable increases in the purchase of ASW ordnance, sonobuoys and other equipment.

The second largest amount of missile money—$62 million—would go to the Air Force. The money would be used for purchase of *Sidewinders*, *Bullpups* and air-to-air *Falcons*, as well as other tactical missiles.

The Army would receive $33.8 million for missile procurement. Of this, $14.6 million would be spent on surface-to-air *Hawks* and high-explosive warheads for *Nike-Hercules* batteries. The remaining $19.2 million would be spent on *Honest John* surface-to-surface missiles and high-explosive *Honest John* warheads.

The three services would receive $558.7 million for the procurement of tactical aircraft—from helicopters to supersonic interceptors. They also would receive about $800 million for the purchase of other ammunition and equipment.

• **Swelling manpower** — The requests were considered impressive, particularly in comparison with limited war requests in recent years. However, even more impressive were the Administration's requests for increasing the size of the nation's ground and sea forces.

A total of 225,000 men would be added to the Armed Forces bringing the total number of men in uniform to 2,743,000. The Army would be increased from 875,000 to 1 million men.

Defense Secretary Robert McNamara told the Senate Defense Appropriations Subcommittee, in submitting the new budget requests less than 24 hours after Kennedy announced them, that the Army would be increased from 14 to 17 divisions.

Even more important, McNamara said that the number of combat-ready divisions in the United States would be increased from three to six, and that divisions overseas would be strengthened.

Finally, the level of readiness of Army reserves in the United States will be increased.

• **Only beginning**—Officials already have made clear that these moves are not being planned as an answer to Berlin alone but as an overall increase in the nation's ground forces for the years ahead. This can only mean a much larger build-up of stockpiles of tactical missiles and other equipment—or even greater shortages than the Army has been experiencing.

For years the Army has sought and been rebuffed in its pleas for sufficient modern equipment for its 14 divisions, a number of which are under strength. Procurement requests for new missiles, tanks, rifles and other equipment have consistently been cut. The shortages that have developed can not be eliminated by the new Kennedy increase alone.

Therefore, the Kennedy requests are considered to be only a beginning in a move to re-establish the nation's ground forces as a major factor in deterring Communist trouble-making around the world. Much larger appropriations will be needed in the next few years to complete the job.

Such increases—along with others to enlarge U.S. strategic striking forces and develop advanced missiles, aircraft and space weapons—could easily push the defense budget to nearly $50 billion in FY '63.

In fact, with the new increases, the defense budget would not have too far to go. Kennedy's additional $3.4 billion brought the total military appropriations sought for FY '62 to $46.2 billion.

That is more than $5 billion over the

Boost in Tactical Missiles

New Obligational Authority in billions

	Eisenhower Budget	Kennedy Revises 1-2	Kennedy 3rd Revise	Total Changes
ARMY	10.5	10.3	11.8	1.3
NAVY	12.2	13.5	14.5	2.3
AIR FORCE	17.8	17.7	18.3	0.5
OSD	1.3	1.3	1.5	.2
TOTAL	40.9	42.9	46.2	5.3

amount sought by President Eisenhower in his lame duck defense budget last January. It is some $2 billion more than Kennedy indicated would be needed during the presidential election campaign.

• **Deliberate speed** — However, despite his campaign charges that the Republican Administration had allowed the nation's military strength to deteriorate, Kennedy did not reach the point of seeking sizeable increases swiftly.

His first revision of the defense budget in February and his second in late March made some adjustments and sizeably increased the number of *Polaris* submarines under construction. Otherwise there were no major additions.

Only this month, when confronted with the growing belligerence of the Soviets and new multibillion-dollar increases in Soviet defense spending, did Kennedy move.

"The immediate threat to free men is in West Berlin," he told a nationwide TV and radio audience July 25. "But that isolated outpost is not an isolated problem.

"The threat is world-wide. Our effort must be equally wide and strong."

Then he outlined the steps he proposed to take to meet this threat. And he solemnly warned the Soviets:

"We do not want to fight—but we have fought before. . . . Three times in my lifetime our country and Europe have been involved in major wars. In each case serious misjudgments were made on both sides of the intentions of others which brought about great devastation."

• **Expanding alternatives** — A key theme that ran through Kennedy's speech and that formed the basis of much of what he proposed to do was the need for broadening the choice of military and diplomatic response that he possessed as Commander in Chief. It was recognition that, by seeking something close to a minimum strategic deterrent, the United States had to a great extent vitiated the Soviets' belief that the strategic bludgeon would ever be used—except to retaliate against an all-out attack on North America.

By building up the Army Kennedy made clear that he was trying to develop a new deterrent—to meet the Communists with conventional weapons if necessary.

". . . I must emphasize again that the choice is not merely between resistance and retreat, between atomic holocaust and surrender."

McNamara echoed the theme the next day before the Senate Subcommittee. He said:

"We need to expand the range of military alternatives available to the President in meeting the kind of situation which may confront us in maintaining our position in Berlin."

However, McNamara also added pointedly:

"I want to make clear . . . that this does not mean we are lessening the effectiveness of our tactical nuclear capabilities."

• **Is it enough?**—Many Army officials would add that it is a good thing—and that the United States had better strengthen them rapidly.

Few military men would argue seriously that NATO could outfight the Red Army in the heart of Europe today without the use of tactical nuclear weapons. Nor would the addition of several more divisions to NATO be sufficine to make a return to conventional weapons possible.

For this reason, some Army strategists felt that Kennedy's new budget requests did not go far enough in that they made no provision for buying more tactical nuclear missiles such as *Pershing*, *Sergeant* and *Davy Crockett*. Moreover, there was disappointment that the President did not press ahead with the resumption of underground nuclear testing so that tactical nuclear missiles might be greatly improved.

Their argument received support earlier this month in Moscow. Russia announced the reorganization of the Red Army into small, independent rocket units designed to fight nuclear wars. ⌗

PROCUREMENT INCREASES
(In Millions)

	Missiles	Aircraft	Other	Total
ARMY	33.8	36.7	481.5	552
NAVY	262	281	166	709
AIR FORCE	62	241	122	425

Nearer to moon...

Ranger I Is Most Sophisticated U.S.

NASA discloses details of lunar craft designed to go into orbit atop Agena B with eight new experiments

THE UNITED STATES prepared last week to put the *Ranger I* lunar spacecraft through its first flight test in space.

In anticipation of the shot—the first NASA use of an *Atlas Agena B*—NASA lifted the lid of secrecy it had kept battened over *Ranger's* instrumentation.

Besides "road-testing" the reliability of the spacecraft, the shot was intended to check out such new equipment as an attitude stabilization system based on celestial reference, a high-gain pointable antenna, an advance communication system, the development of new components able to operate for long periods in space environment, and calibration of solar cells in a space environment.

Eight new scientific experiments were aboard the hexagonal *Ranger*. Most were to study the nature and activity of cosmic rays, magnetic fields, and radiation and dust particles in space. One will seek an answer to the question of whether the earth carries along with it a comet-like tail of hydrogen gas.

Ranger I, for which Jet Propulsion Laboratory is prime contractor, was not designed to hit the moon. It was to be launched into a long trajectory which will eventually place it in a highly eccentric earth orbit with an apogee of 685,000 miles and a perigee of 37,500 miles.

This orbit would allow it to burn up in the earth's atmosphere after a round trip of perhaps 50 days. There was a possibility that if the rocket malfunctioned slightly *Ranger I* would reach escape velocity and speed into an orbit around the sun.

• **Last word**—*Ranger I* is America's most advanced spacecraft. It is slightly more than 5 ft. in diameter at the base of the hexagon and 11 ft. long. In its cruise position, with its solar panels extended to collect energy from the sun, it is 17 ft. in span and 13 ft. wide. It weighs 675 lbs., of which 243 lbs. is electronic equipment, 144 lbs. is scientific experiments, 50 lbs. is solar panels, and 238 lbs. is its structure.

Rising from the hexagonal base are four struts and four diagonal braces made of aluminum which support scientific instrumentation. The spacecraft has two radio transmitters and two antennas, one an onmidirectional antenna at the front end and the second a high-gain directional antenna, 4 ft. in diameter, at the base of the spacecraft. The latter will be aimed at the earth in order to permit more efficient transmission of data after *Ranger* is out in space.

The solar panels are each approximately 10 sq. ft. Each contains 4340 solar cells to collect sun energy. They are expected to pick up enough solar energy to be converted into a minimum of 155 watts and a maximum of 210 watts.

In the hollowed-out inner section of the hexagon is a 125-lb. silver-zinc battery with a capacity of 9000 watt hours. This will run the spacecraft prior to the use of the solar panels. It will provide enough electrical power to run the spacecraft for two days.

Before solar power is available, the two radio transmitters on board will both start sending data to earth via the omnidirectional antenna. A three-watt transmitter will send on a frequency near 960 megacycles and a separate quarter-watt transmitter will send on a similar frequency. The quarter-watt transmitter has a lifetime of seven days.

• **Controller** — Perhaps the most sophisticated piece of equipment on board is the electronic controller which allows *Ranger* to calculate when it should perform its various functions.

It is an electronic solid-state timer which takes 400 cycles per second from the spacecraft power source, divides it into one pulse per second, and uses these pulses as the basic timing reference.

These pulses are accumulated in a storage device. The unit also contains a memory device which has a preset series of triggers. When the accumulated pulses per second match the preset count stored in the memory device, a relay is closed and the controller issues a command for *Ranger* to perform some specific function. From launch to the end of its useful life there are 10 such commands that the controller must issue; hence there are 10 such channels and 10 relays.

The controller is started three minutes before launch. After launch it serves as the reference point for future commands to be issued by the controller.

• **Liftoff to trajectory**—The *Ranger I* spacecraft will be lifted from Cape Canaveral by an *Atlas Agena B* booster with a thrust at sea level of about 360,000 lbs.

All engines of the *Atlas*—booster, sustainer and vernier—are burning at liftoff. The booster is programed to burn approximately 2½ minutes, the sustainer about 4½ minutes and the verniers about 5 minutes. At *Atlas* burnout the vehicle should be about 80 miles high and some 350 miles down the Atlantic Missile Range.

At this point, the *Agena B* separates from the *Atlas*, fires for the first time and burns for almost 2½ minutes to reach an earth-orbit speed of approximately 18,000 miles per hour. After 2½ minutes of burning time, *Agena B* shuts down and coasts in a parking orbit for more than 13 minutes, until it reaches the optimum point in its orbit to fire for the second time.

Injection of the *Agena B* and the *Ranger I* spacecraft, still as one unit, occurs approximately over Ascension Island in the South Atlantic Ocean 23 minutes after launch.

A little more than 2 minutes after injection, *Ranger I* is separated from *Agena B*. After this occurs, *Agena B* does a 180-degree yaw, fires up some solid retrorockets and moves into a different and lower trajectory from that attained by *Ranger I*. The spacecraft is now pointed on a trajectory which will take it on a long swing away from earth.

• **By the numbers**—The sequence of commands given by the controller provides a complete description of the operations of *Ranger I* on its long journey into space.

—First Command—This is issued 25 minutes after the controller was started (three minutes before launch time). This command is to the big silver-zinc battery to increase the power being sent to the larger transmitter from 1.5 watts to 3 watts.

—Second Command—This is issued at 35 minutes and turns on the scientific instruments not turned on during the passage to the critical altitude area at between 150,000 and 250,000 ft.

—Third Command—This is issued at 36 minutes and extends, by means of a compressed spring, the electrostatic

analyzer package in a small box on a boom about four feet from the main body of the spacecraft. This enables the two sensors in the analyzer to look at the sun and away from the sun at the same time. The same command displaces two pins which moves the solar panels out.

—Fourth Command—This occurs at 61 minutes, 40 seconds and takes place while *Ranger I* is still staggering through space from the shock caused by separation from *Agena B*. This command turns on the attitude control system and sends power to the sun sensors, the cold gas jets, and the gyroscopes.

The sun sensors, working on the valves controlling the gas jets, jockey the spacecraft about until its long axis is pointed at the sun.

Once it is locked on the sun, the power system, recognizing that it is getting electric power from the solar panels through the converters, switches off the large zinc battery.

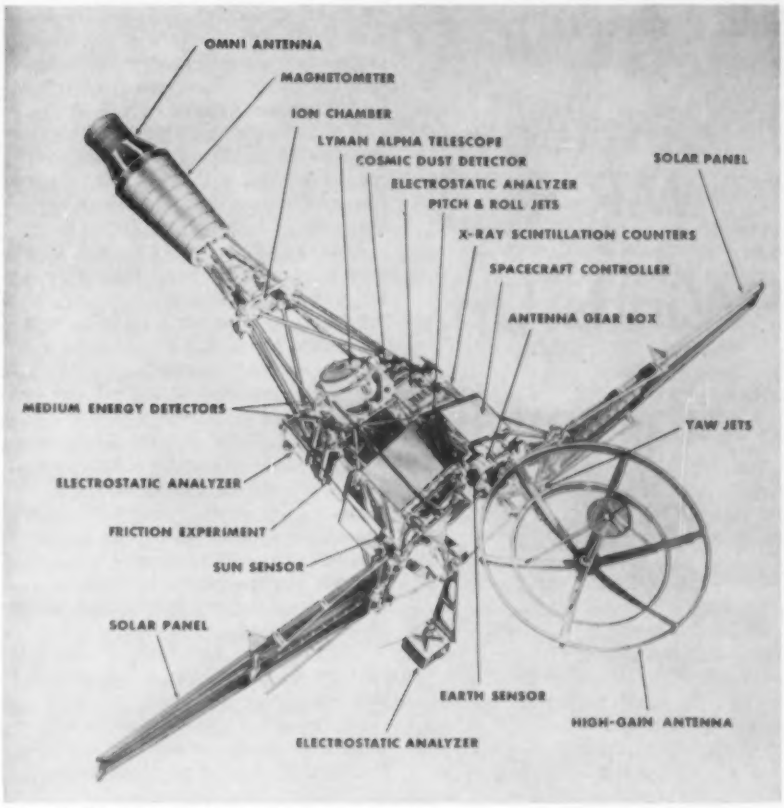
—Fifth Command—This takes place at 90 minutes and forces *Ranger*—now locked on the sun—to start looking for the earth. The spacecraft then starts to roll on its long axis pointed toward the sun, with its directional antenna extended at a precalculated attitude. During the roll, the earth sensors will see the earth and inform the gas jets. The jets will fire to keep the earth in view of the sensors—and thus lock onto the earth.

—Sixth Command—This occurs at 118 minutes and changes the scale factor of telemetry measurement of the wobbling *Ranger* went through when separated from *Agena B*. The wobbling —now under the control of the attitude control system—has considerably lessened and the scale factor must be reduced.

—Seventh Command—At 200 minutes, it makes an instrument in one of the experiments more sensitive, to provide a finer measurement of the radiation levels encountered.

—Eighth Command—This occurs at 250 minutes and transfers data being sent from the three-watt transmitter from the omnidirectional antenna to the directional antenna, thereby greatly increasing the range from which the information can be sent.

—Ninth Command — This takes place at 366 minutes, 40 seconds. It consists of a reduction in the rate at which the quarter-watt transmitter has been sending data over the omnidirectional antenna. The low-power transmitter now is near its limits because of distance, so that the amount of information it sends is reduced and its ability to communicate over longer distance is improved.



DETAILED DRAWING of Ranger spacecraft.

—Tenth Command—This occurs at 370 minutes and turns on an engineering experiment to try to determine some of the friction forces involved in the operation of machinery in the hard vacuum of space.

• **Experiments**—The eight experiments included in *Ranger I* are some of the most important attempted by U.S. space scientists. They include:

—Solar Corpuscular Radiation Experiment—To determine the flow and movement of interplanetary plasma (clouds of charged particles) by observing the density and direction of motion of drifting plasma clouds and also by measuring the energies of the particles which make up these clouds.

—Medium-Energy Range Particle Detectors — Six medium-energy range particle detectors will observe charged particles in an energy range which overlaps the lower energy range of the solar corpuscular radiation experiments and which extends upward toward the high energies of the fast-moving cosmic rays.

—Cosmic-Ray Ionization Rate Measurement—Primary cosmic radiation and other ionizing radiation in the space beyond the earth's atmosphere will be measured by a quartz fiber, integrating tube ionization chamber.

—Triple-Coincidence Cosmic Ray Experiment—High-energy radiation in interplanetary space will be measured by an instrument composed of two triple-coincidence telescopes, each of which has seven proportional counter tubes.

—Magnetic Field Experiment—*Ranger* carries a rubidium vapor magnetometer to measure the strength and direction of the magnetic field in interplanetary space.

—Solar X-Ray Detection—A pair of scintillation counters are mounted on *Ranger* to detect bursts of low-energy X-rays originating at the sun. The equipment is designed to detect extremely short-term variations in the X-rays.

—Neutral Hydrogen Geocorona—This experiment employs a telescope and a detector sensitive to the Lyman-alpha region of the spectrum (the color of the neutral atomic hydrogen gas) which will scan the region containing the earth.

—Cosmic Dust Detectors—Impact rate, energy, momentum and direction of flight of dust particles in interplanetary space will be measured by a miniature cosmic dust detector. ■

Shaky success...

MR-4 Winds Up Suborbital Series

by Hal Taylor

CAPE CANAVERAL—Flight of *Mercury Redstone 4*—perhaps the closest success ever came to failure—apparently was the last U. S. manned sub-orbital shot down the Atlantic Missile Range.

Only totally unexpected telemetry evidence of capsule malfunction could require a third such shot and, judging from preliminary data, this seems highly unlikely.

NASA officials are expected to decide this week to drop the *Redstone* series and concentrate on *Mercury Atlas* orbital shots. The next in this series, an unmanned *MA-4*, has slipped from mid-July to early September.

NASA has discovered that the loss of the $2-million "Liberty Bell 7" capsule aboard *MR-4* July 21 could have been avoided—except for a faulty warning light. Marine Helicopter Pilot Lt. James L. Lewis, who was retrieving the waterfilled capsule, cast it loose when the warning light indicated the helicopter's engines were overheating.

The capsule sank in 18,000 fathoms of water.

Subsequent investigation showed nothing wrong with the engines, but with the light.

Astronaut Virgil L. "Gus" Grissom himself narrowly escaped drowning at the end of the 15-min., 118-mi.-high and 303-mi.-long flight when an escape hatch blew out prematurely, flooding the capsule. Grissom had to swim through it to safety. A neck dam kept his space suit from filling with water and also trapped air in the suit, providing buoyancy at first. However, the suit did start to fill from a port he had left open; by the time he was picked up by another helicopter, Grissom was fighting hard to stay afloat.

Except for the unexpected blow-out of the escape hatch, Grissom's flight was almost a carbon copy of the 116.5-mi.-high and 302-mi.-long flight of Cmdr. Alan Shepard May 5, and was fairly close to the programed 116-mi. apogee and 287-mi. distance.

• **Operational problem** — Although there was speculation that RF energy from the helicopter might have actuated the explosive charge, NASA officials said telemetry showed nothing wrong technically with the escape hatch mechanism. They put it down as an operational problem not requiring any design changes.

The space agency presently plans to set up a procedure under which safety pins—which prevent its premature release—will be kept in the hatch mechanism until the astronaut is ready to make his exit.

It also plans further egress training for the astronaut and the Marine helicopter rescue team. Many rehearsals will be run through in an attempt to smooth out and speed up the lowering of two lines to the capsule simultaneously with lowering the harness to pick up the astronaut.

A review also has given the capsule's control system a clean bill of health. Grissom reported shortly after the flight that he did not get the movement expected while using the attitude control system. Telemetry records indicate that the system worked perfectly. Grissom's statement, according to NASA officials, probably stems from the fact all of his earlier experience in using the system was at sea level. The reaction of the controls is a little slower in powered flight.

Grissom also said that his HF (high frequency) radio did not work during his flight. The space agency says that it never expected the HF radio to work particularly well on suborbital flight. It is intended as a backup for the ultra-high-frequency radio on orbital flights, when it will be used for skip transmission ranges.

NASA officials also expressed complete satisfaction with the performance of the *Redstone* booster. They pointed out that the planned velocity was 4480 miles per hour, and the space agency got 4510 miles. The slight variation resulted in 1½-mile higher altitude than planned. ⁂

ASTRONAUT GRISSOM vainly tries to assist Marine helicopter in recovery of Liberty Bell 7 capsule. Minutes later he nearly sank himself.

For ComSat System...

Carriers Plan Non-profit Ownership

INTERNATIONAL carriers are expected to advance a new plan wherein they would create a non-profit corporation to own and operate a U. S. commercial communications satellite system.

The plan presumably would rule out any profit-sharing in the venture by missile/space industry firms, other than those already in the communications business.

American Telephone & Telegraph and Radio Corp. of America are reported to have authored the plan in answer to a scheme put forth by General Electric to create a profit-making "carrier's carrier" which would own and operate a ComSat system.

Existence of the new plan became known as the Federal Communications Commission last week ordered the eight U. S. international carriers to set up an *ad hoc* committee to recommend proposals for ownership and operation of the system. The FCC acted following a White House policy decision favoring private ownership of a commercial system (see box).

GE and Lockheed Aircraft Corp., which also has sought ownership participation, were excluded from the *ad hoc* committee. FCC officials denied that this meant GE and Lockheed were now out of the running, contending that their proposals would be given equal consideration with those of the carriers.

All of the commission's orders and decisions in the protracted struggle over ownership of the system have stressed the role of the communication carriers and excluded missile/space firms. Hence, it seems clear that if the carriers' new plan fills Administration criteria, it will get the go-ahead.

The plan which AT&T and RCA will present to the committee envisions a non-profit corporation in which the carriers would have equal representation with, perhaps, three directors representing the general public.

Profits for the carriers would come from the toll rates received for traffic originating in their own ground stations.

While chances of the missile/space industry proposals appear slim, there is still the possibility that Congress will insist upon wider ownership participation. There is also the remote chance that the communications carriers will be unable to come to an agreement. GE could also apply to FCC for an international communication carrier license.

The FCC told the *ad hoc* committee to prepare a plan for presentation to the Commission not later than Oct. 13.

Besides AT&T and RCA, the committee will include American Cable and Radio Corp., Press Wireless Inc., Hawaiian Telephone Co., Radio Corporation of Puerto Rico, South Puerto Rico Sugar Co., Tropical Radio Telegraph Co., U. S. Liberia Radio Corp., and Western Union Telegraph Co.

The group is to use the criteria laid down in the President's statement. ■

Text of President Kennedy's policy statement on a commercial communication satellite system:

A. POLICY OF OWNERSHIP AND OPERATION

Private ownership and operation of the U.S. portion of the system is favored, provided that such ownership and operation meet the following policy requirements:

1. New and expanded international communications services be made available at the earliest practicable date;

2. Make the system global in coverage so as to provide efficient communication service throughout the whole world as soon as technically feasible, including service where indivual portions of the coverage are not profitable;

3. Provide opportunities for foreign participation through ownership or otherwise, in the communications satellite system;

4. Non-discriminatory use of and equitable access to the system by present and future authorized communications carriers;

5. Effective competition, such as competitive bidding, in the acquisition of equipment used in the system;

6. Structure of ownership or control which will assume maximum possible competition;

7. Full compliance with antitrust legislation and with the regulatory controls of the Government;

8. Development of an economical system, the benefits of which will be reflected in overseas communication rates.

B. POLICY OF GOVERNMENT RESPONSIBILITY

In addition to its regulatory responsibilities, the U.S. Government will:

1. Conduct and encourage research and development to advance the state of the art and to give maximum assurance of rapid and continuous scientific and technological progress;

2. Conduct or maintain supervision of international agreements and negotiations;

3. Control all launching of U.S. spacecraft;

4. Make use of the communications satellite systems when required to meet unique Government needs which cannot, in the national interest, be met by the commercial system;

5. Assure the effective use of the radio-frequency spectrum;

6. Assure the ability to discontinue the electronic functioning of satellites when required in the interest of communication efficiency and effectiveness;

7. Provide technical assistance to newly developing countries in order to help attain an effective global system as soon as practicable;

8. Examine with other countries the most constructive role for the United Nations, including the I.T.U. (International Telecommunication Union), in international space communications.

C. COORDINATION

I have asked the full cooperation of all agencies of the Government in the vigorous implementation of the policies stated herein. The National Aeronautics and Space Council will provide continuing policy coordination and will also have responsibility for recommending to me any actions needed to achieve full and prompt compliance with the policy. With the guidelines provided here, I am anxious that development of this new technology to bring the farthest corner of the globe within reach by voice and visual communication, fairly and equitably available for use, proceed with all possible promptness.

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Technical Countdown

MATERIALS

Residual Machining Stresses a Problem

Industry is still hunting complete, accurate and practical data on residual machining stresses remaining in critical components after fabrication. In one instance, a case of large precision gears—finished, inspected and approved, were waiting shipment. One morning several of the gears were found split and cracked, presumably from undetectable internal stress induced during machining.

New Hydrospin at Avco-Lycoming

A vertical Cincinnati Hydrospin machine has been installed at Avco-Lycoming. The device is capable of shear-forming parts up to 72 in. across and over 144 in. long. It can easily be equipped with flame devices to form magnesium alloys, titanium, molybdenum and other metals requiring heat. The new machine increases Lycoming's capabilities in the motor case market.

Rhenium-Tungsten Alloy Strip in Production

Chase Brass and Copper Co. is producing rhenium-tungsten alloy strip in commercial quantities. The alloy is used primarily in grids, heaters, cathode supports, thermocouples, electrical contacts and welding filler rods. Powder metallurgy methods are used.

Huge Centrifuge A-building at Pt. Mugu

Rucker Co. will design, build and install a 32-ft.-diameter disc centrifuge at the Navy's Missile Center, Pt. Mugu, Calif. The system will test concentrated packages up to 5000 lbs. in weight. Rated at 50,000 g-lbs. acting 24 in. above the top of the disc, the system will simulate all g forces a missile would be subjected to in flight. Maximum acceleration will be 100 g.

Moly Arc-Castings Ductile

Oregon Metallurgical Corp has produced molybdenum sufficiently pure to be ductile before any mechanical working. Coupons cut from the as-cast ingot showed a 37,000 psi yield strength, 46,000 psi ultimate, 3.5% elongation in 4D and a 3.2% reduction in area at room temperature. The work is sponsored by the Navy's Bureau of Weapons.

PROPULSION

AF Headache—Storables

Despite commitment to current design, the Air Force is still looking for great improvements in the elastomeric seals used in the storage-fueled *Titan II*. Project spokesmen say that nitrogen tetroxide is especially hard to handle during long storage periods.

Case Wound Grains Fired

Aerojet has fired a number of small solid rockets fabricated by winding the glass case directly on the live grain. Another wrinkle in case technology is the firm's technique of plating control and other electrical circuitry directly onto the motor case. The method is believed to be highly reliable and unaffected by heat, vibration and other extremes.

Upper Stage Solid Propellant

Test-firings at extremely low (less than 200 psi) chamber pressures with high combustion efficiency have been achieved by Grand Central Rocket with its Polycarbutene-R propellant. The possibility of using light motor cases aids in reaching high-propellant mass fractions. The GCR propellant fired at low pressure contained substantial amounts of powdered aluminum, once considered a major obstacle in such firings.

Calibrated Flowmeter Licensed

Rocketdyne-developed Volumetric Flowmeter Calibrator —a method of calibrating flowmeter systems to an accuracy said to be greater than by any other method—has been licensed for production and sale to Norlac Engineering and Mfg. Co., Culver City, Calif. Currently in use at Rocketdyne-Neosho, the device consists of a pressurized supply tank, test and flow control station, volumetric standpipe and return unit and a control and recording unit. Calibration is effective over wide ranges of pressure and flow rates.

ASW & SEABORNE SYSTEMS

Drone Extends ASW Striking Power

A remotely-controlled drone—nicknamed DASH (Drone Antisubmarine Helicopter)—has extended the Navy's ability to hit hostile submarines to the limits of its sonar detection capability. Flown from the deck of a destroyer, the Model DSN-1 coaxial-rotor helicopter is armed with homing torpedoes and allows the Navy to attack subs before the enemy craft become aware of the attack. The new drone was developed and produced by Gyrodyne Company of America, Inc.

ELECTRONICS

Feedback Communications Under Study

A study program to improve understanding of the operation of feedback communications systems is being undertaken by Sylvania for the Air Force. Communications systems of this type continuously monitor the received signal strength, and, by feeding this information back to the transmitter, can vary its transmitted signal to maintain high communications performance levels. Systems of this type are expected to yield substantially improved communications.

ASTRONAUTICS

Digging a Hole on the Moon

Tests conducted at NASA's Lewis Research Center with high-pressure jets impinging into beds of sand in a vacuum chamber indicate that the retro-rockets of a lunar spacecraft will dig a sizable hole upon landing. After up-scaling the test results, NASA scientists found that, with a jet nozzle located 100 feet above the lunar surface, a hole some 30 feet deep and 100 feet in diameter may be produced. It was also found that the sand particles are thrown up and out, leaving a dust-free central cone for the landing craft.

Ballistic Actuator Would Open Silo of

by Frank G. McGuire

MESA, ARIZ.—Even if buried in a nuclear attack the Air Force's *Minutemen* will still be able to retaliate—thanks to a solid-powered ballistic acuator system for removing the silo lids.

An actuator produced for The Boeing Co. by Talley Industries, Inc., exerts some 350,000 lbs. of force to remove the lid and any debris that might be covering it after an enemy assault. Boeing expects that the maximum load will total about 160,000 lbs. The actuator will move that weight eight feet in less than six seconds.

Operating by means of a pulley system, a cable will transmit the eight-foot piston movement to the lid, unlocking it and giving initial movement to send it away from the silo, plowing away debris in its path. The concrete and steel lid will then roll on steel rails across the apron of the silo.

Talley has already completed preliminary development of the actuator under a $56,000 contract, and has received a $79,000 follow-on contract for further development and qualification.

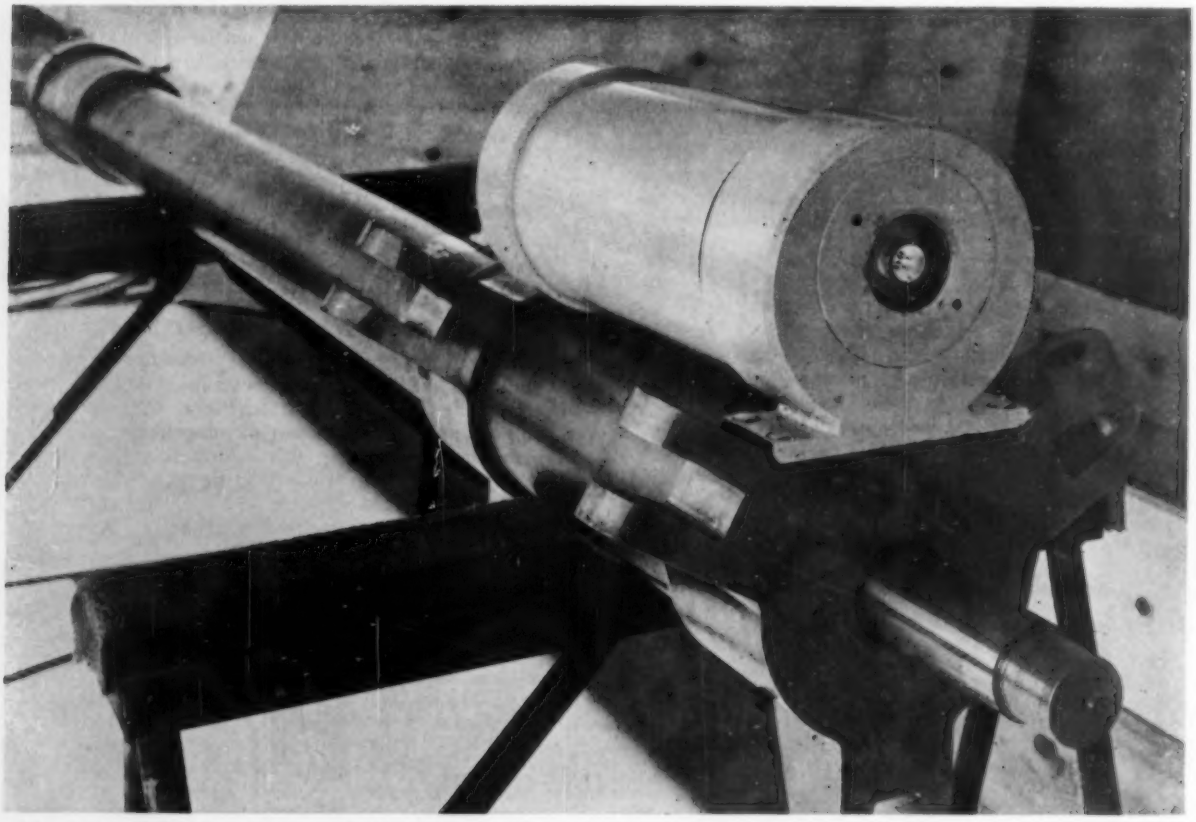
Talley is the sole source on the lid-removal system. A similar contract has been awarded the firm by the Army for development of a solid-propellant lid-removal system for the *Titan II*. This contract is for $497,000.

G. E. Hirt, vice president of Talley, said the *Minuteman* actuator represents the first time industry has broken away from the concept of relying on electric motors instead of ballistic actuators for such a vital application.

"This type of actuator has often been used as a backup system," Hirt said, "but never as the sole energy source where so much is at stake."

The noiseless actuator utilizes over three pounds of a very stable ammonium nitrate propellant. It can be stored over a year, then maintaining full operational capability during at least three years in position. One unit will be used per silo—and Boeing's confidence in the Talley device is such that no backup system is planned for the application.

Operating pressure will vary from 400 to 15,000 psi under varying load conditions, but the actuator cylinder has been built to withstand a peak pressure of at least 20,000 psi. Ignition of the main propellant charge is assured through the temperature range −45°F to +160°F, by 13 TEX 506 charges



ACTUATOR CARTRIDGE atop cylinder. The cartridge is sealed at one end by a styrofoam closure which ruptures at approximately 25 psi. The seal keeps hot igniter particles in the cartridge long enough to insure ignition before gas is released.

Minuteman after Nuclear Attack

1.1-in. long, uninhibited on both ends.

The bore of the cylinder, as well as the piston, has been hard chrome-plated to protect the surfaces against any corrosive action of the propellant gases during repeated firings for silo lid removal. Backup rings have been included in the piston and bearing insert seals to prevent failure.

The end cap assembly has been machined to provide for a scraper that will prevent foreign material deposited on the piston rod from interfering with the operation of the actuator over a period involving a number of firings.

Design of the cartridge assembly was carried out as a result of a computer study program conducted at Princeton University last year.

The propellant cartridge is sealed at one end by a styrofoam closure which ruptures at about 25 psi. The seal performs two functions in that it keeps the hot igniter particles in the cartridge long enough to insure propellant ignition before releasing gases into the main cylinder, and when covered with an epoxy resin acts as environmental seal.

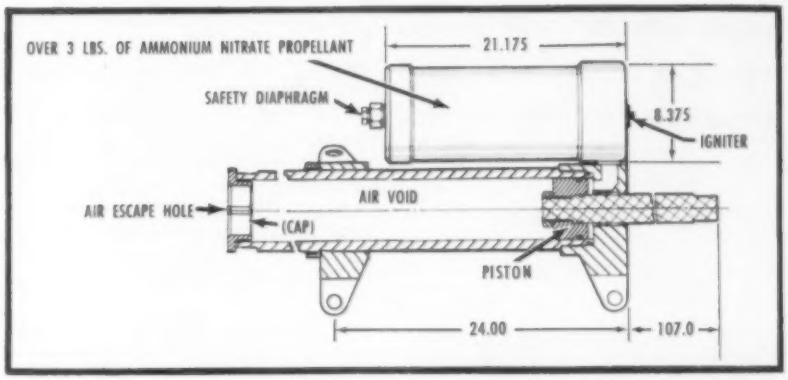
Peak resisting load in the system occurs about 18 inches from the top end of the cylinder.

Talley says it is apparent that the propellant grain can, at −40°F, produce sufficient gas to move the piston through its 96-in. stroke in barely three seconds without exceeding 0.25 g on the piston.

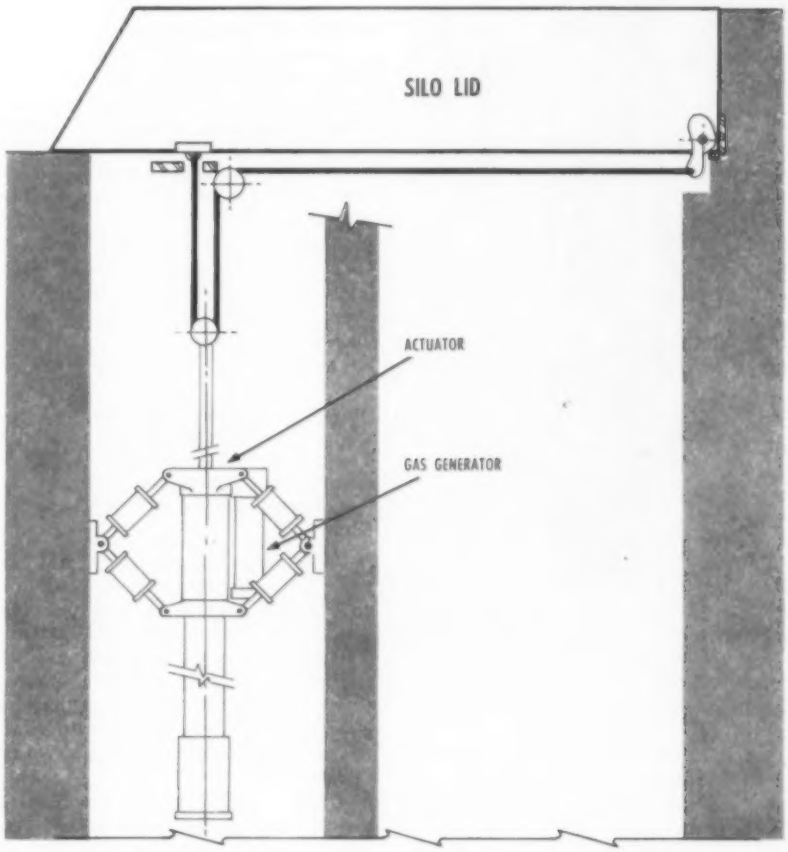
• **Simulator design**—Due to the undesirability of completely duplicating a *Minuteman* silo at the Talley facility, a simulator was developed, described by Hirt as "the biggest water pistol in Arizona."

The device consists of a cylinder filled with water and having a hole at one end. A variable diameter probe is positioned to move through the hole, giving variable resistance to the piston, which exerts force on the water from the opposite end of the cylinder. By carefully machining the probe, Talley was able to control the water expulsion and thereby duplicate the resistance expected at various phases of the silo lid removal.

Several different probes were used, to simulate varying load conditions anticipated during operation. ⁂



CUTAWAY OF ACTUATOR. It can be stored for longer than one year and then maintain full operational capability for at least three years in position.

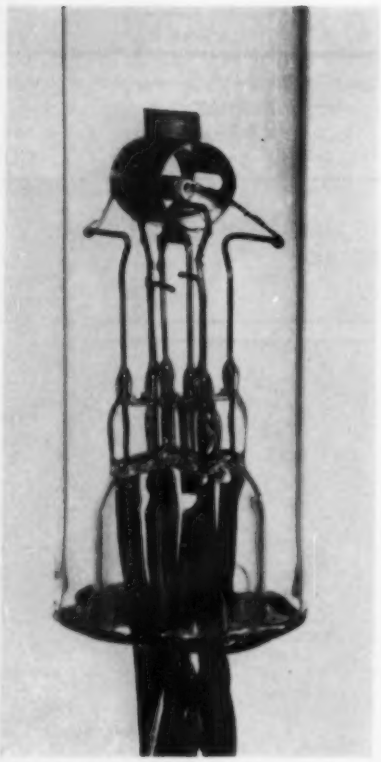


IN MINUTEMAN SILO, eight-foot piston movement created by Talley actuator would be transmitted to lid by means of a pulley system. Total force: 350,000 lbs.

Door Open to 'Low-Temp' Thermionics

FICO-built converter spells longer life for cells using readily available materials; a step toward noiseless subs

by William Beller



LOW-TEMPERATURE, wide-gap thermionic test cell. This is a close-up of a cylindrical-geometry type.

LONG ISLAND CITY, N.Y.—A thermionic converter which can operate at much lower temperatures than had been thought possible for reasonable performance is emerging from the research stage at Ford Instrument Co.

The achievement of a relatively low-temperature converter is highly significant. It means that readily available materials can now be used in the cells, because high-temperature problems have been reduced. It also means that the life of the materials can be greatly prolonged, thus enhancing system reliability.

In a broader view, the cells may be bringing the Navy a little nearer to realizing its dream of a noiseless submarine powerplant. It may also mean that solar thermionic power generators will become easier to design. And "low-temperature" thermionics undoubtedly can open up many applications not practical with present cells.

Test cells have already shown conversion efficiencies up to 15% and densities of 5 watts per square centimeter, at the surprisingly low temperature of around 1200°C. This operating temperature is far lower than that of other converters, whose emitters usually work at about 1800°C.

These research test cells have been operating on a laboratory basis at Ford Instrument for nearly a year. Until now they were given no publicity because the scientists wanted to be sure that the test results would repeat themselves.

Theodore Jarvis, who heads up Ford Instrument's thermionics work, says that within six months the company will be going from glass models to metal-ceramic ones; within a year, he expects, the company will be having production units.

• **Wide gap used**—The secret behind the Ford Instrument work is that an ultra-low-voltage arc is struck and maintained between the cell's emitter and collector; other cells don't use an arc. An additional, striking development is that the gap between the emitter and collector is 0.1 in.—one or two orders of magnitude bigger than the gap used in other cells.

Jarvis says that a little over a year ago he was experimenting with a thermionic triode. He noticed that once an arc was established, reducing the grid temperature had no effect on the current. He concluded that the grid was only a triggering device to get the arc started. Once it was established, Jarvis found he could get good thermionic efficiencies with relatively low plate temperatures.

The operation of the thermionic tube is often compared to that of the vacuum tube diode. In each, electrons are boiled off the emitter or cathode, migrate across the interelectrode gap, and condense on the collector or anode. In the thermionic tube, this current of electrons passes through a load, does work, and returns to the emitter for another cycle.

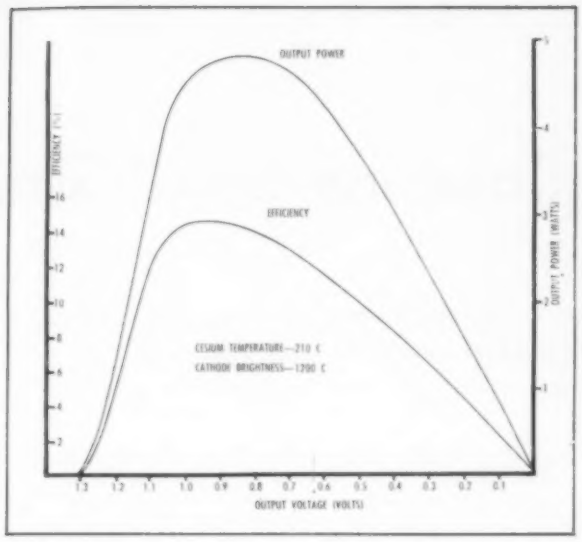
The gas-filled or cesium cell is popular today because it lessens the space-charge in the tube, makes suitable contributions to the work functions of the emitter and collector, and allows a larger interelectrode gap than the vacuum cell. Ford Instrument's converter is the cesium-gas type.

• **A theory needed**—At present, no one appears to have a reasonably full understanding of the theory behind the ultra-low-voltage arc converter. However, the process does involve direct electron-produced ionization within the volume of the arc discharge, and does not involve surface effects caused by Langmuir-type ionization.

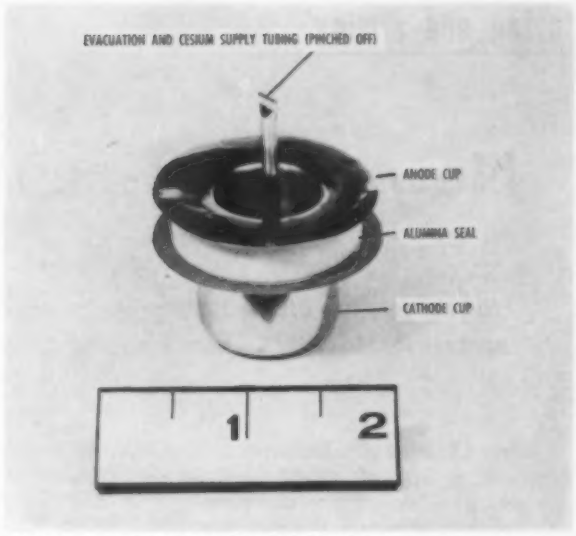
The discharge is described as distinguished by a rapidly rising potential within the discharge itself up to a potential maximum. This maximum may be a localized "ball-of-fire discharge" that in some instances fills the entire interelectrode spacing—the Langmuir discharge.

The ion-producing electron reactions take place inside this reaction zone. The conduction electrons, as well as those which caused excitations and ionization of the neutral atoms, then drop to the collector and complete the circuit.

All of the foregoing characteristics of the ultra-low-voltage arc have been observed during the experimental work at Ford Instrument. As the interelectrode gap is reduced below about 0.07 in., or if the current density drops significantly the arc is extinguished. This phenomenon is said to be consistent with the requirements that a certain number of electron-scattering mean-free patterns exist between the emitter and collector for the arc to be sustaining.



OUTPUT POWER and conversion efficiency characteristics of cylindrical-geometry type cell.



MOCK-UP OF FORD INSTRUMENT'S metal-ceramic "low-temperature" thermionic cell.

Here are some uses foreseen for the development—if it lives up to its promise:

—In the antisubmarine warfare field, a nuclear reactor would furnish heat to a thermionic-cell array, which in turn would generate—noiselessly and reliably—a submarine's electrical power. Since the cells would not have to be integral with the reactor cores but rather could get heat from the reactor coolant, the reactor itself could be almost completely isolated—thus making shielding a relatively easy problem.

—Solar power will be fairly easily stored and used. For instance, heat-storage for cells operating in the 1800°C range is extremely difficult. Therefore, earth-orbiting satellites using thermionic cells would have to store electrical energy for darkside operations. On the other hand, if the emitter can be operated off a 1200°C source, an extremely simple and lightweight beryllium heat-storage unit could energize the cell during its dark periods.

—Lower temperature operation also means that the solar mirrors serving thermionic arrays would not have to be as accurately oriented as they would for higher temperature operation.

—Chemical combustion can also be used as an energy source for the Ford Instrument cells. Such a use was recently announced by Atomics International; the company has operated a conventional "cesium vapor diode" with the heat input from combustion of propane gas.

Part of Ford Instrument's work on thermionics is done under a Wright Field contract. It calls for developing and operating a 75-watt electrically heated thermionic cell which will demonstrate the performance of low-temperature plasma conversion.

In addition, under an Office of Naval Research contract, Ford Instrument is studying the fundamental nature and characteristics of pure-cesium and cesium-oxygen plasma arcs.

• **Thermionics today**—Through ONR's Power Branch and LCDR John J. Connelly, who manages many of its thermionics programs, the Navy has become one of the chief backers of fundamental thermionic research. Also, the Air Force, Advanced Research Projects Agency, NASA and the Atomic Energy Commission are firmly in the field. Here are some more interesting programs:

ONR has a joint program with the General Motors Research Laboratory to develop a noble-gas plasma diode. The converter is described as consisting of a uranium-bearing cathode, low work function anode, and a noble gas in which a plasma is formed by fission fragment ionization.

In another ONR program, Atomics International is looking into the feasibility of using a thermionic diode for direct conversion of heat to electrical power in large nuclear powerplants.

General Atomic is studying the thermionic emission characteristics of UC, ZrC and combinations of the two compounds for potential emitter materials in a cesium plasma diode.

Republic Aviation Corp. is looking into the effects of magnetic fields on the electron transfer between emitter and collector. One intriguing aspect of this work calls for applying magnetic modulation in an attempt to generate an alternating current.

Allied Research Associates, Inc. is studying the atomic and solid-state structural factors of thermionic converter materials. This should lead to knowledge of the classes of materials, and even the materials themselves, which are best suited for thermionics.

Armour Research Foundation is studying the problems apt to be brought up in choosing seals and insulators for thermionics. And North Carolina State College is reviewing all ONR contracts on thermionic energy conversion. ■

Characteristics of 'Low-Temperature' Thermionic Cell

Geometry	—cylindrical
Cathode material	—impregnated tungsten, Philips Type B
Cathode dimensions	—0.156 in. D x 0.375 in. L
Cathode surface area	—0.184 in.^{2} = 1.18cm^2
Cathode emission area	—approximately 1.0 cm^2
Anode material	—sheet molybdenum, 0.020 in. thick.
Anode configuration	—cylindrical with four longitudinal fins
Anode dimensions	—0.35 in. D x 1.50 in. L
Anode fin dimensions	—0.40 in. W x 40 in. T x 1.50 in. L
Total external anode area	—5.0 in.^{2}
Cathode-to-anode spacing	—0.10 in.

New Army Timers Combine Small Size,

Honeywell-developed outgrowth of Asroc unit has shown accuracies to 0.1%; hundreds of military and commercial uses seen

by Charles D. LaFond

NEW, RUGGED, 50-hour timers now being developed for the Army could push all conventional timing, fuzing, and arming devices into obsolescence.

One of these—a tiny solid-state magnetic-core timer—is so promising its developers will soon place it in quantity production for commercial and industrial use.

A second-generation outgrowth of the *Asroc* magnetic timing unit, the Minneapolis-Honeywell-developed subsystem has demonstrated accuracies to 0.1% over a wide temperature range. One-cubic-inch timers are now being environmentally tested by the Army's Diamond Ordnance Fuze Laboratories (DOFL) in an extension of its Copperhead fuze-improvement program.

Not only is the new unit an advancement in the art of timer-circuitry design, but Honeywell believes that the fabrication techniques employed also represent significant technological achievement.

Although DOFL funded it, the sponsor of this program to develop advanced 50-hour timers is the Army's Piccatinny Arsenal at Dover, N. J. Three organizations are involved in the three-pronged development approach: Minneapolis-Honeywell, DOFL, and International Telephone and Telegraph Corp. First end-use is still classified, according to Piccatinny Arsenal.

Honeywell's development task required use of transistorized circuitry and a low-frequency magnetic-core oscillator; DOFL, nearly all-magnetic circuitry; ITT, a high-frequency crystal oscillator and transistorized circuitry.

All of the new timers are considered more highly advanced than those resulting from DOFL's Copperhead program (M/R, July 17, p. 119). State-of-the-art switching is employed to permit interrogation prior to final timing.

Any of the timers can be cascaded for any desired total time. The limiting factor is the available power source.

Each timer was built in nine months, according to DOFL, and environmental testing of prototypes will require a total of several months.

In the magnetic timer business since 1955, Honeywell developed its first units solely with in-house funds. It is now setting up automated production lines. Devices so far have employed manually welded circuitry.

Even with current fabrication techniques, the company says, it can effect savings up to 66% over conventional timers.

Key to the success of the M-H timer is the magnetic core's ability to integrate a voltage with respect to time. This provides a means for generating accurate time intervals. Used with a few counter stages, these timers provide very long, extremely accurate time delays.

Use of the magnetic timing technique with solid-state circuitry has achieved characteristic accuracies of better than 0.5% over a temperature range of −65° to 165°F and a ±10% voltage variation. More advanced versions, developers say, are accurate to ±0.1% and are approaching ±0.05%. Some devices have been tested up to 250°F with the same accuracy.

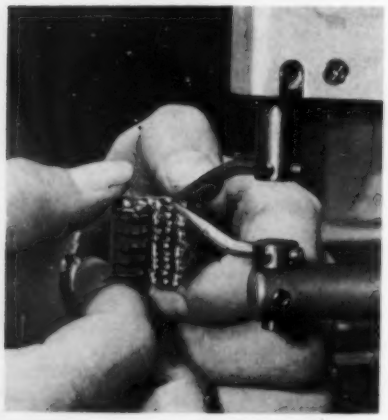
Repeatibility at constant temperature is reported to be better than 1 part in 10^5.

• **Typical interval timer**—The complete timer circuit is comprised of a low-frequency magnetic oscillator and a three-stage decade divider.

The oscillator generates a square-wave output pulse nearly immune to the frequency drift normally caused by ambient temperature changes and/or supply voltage fluctuations.

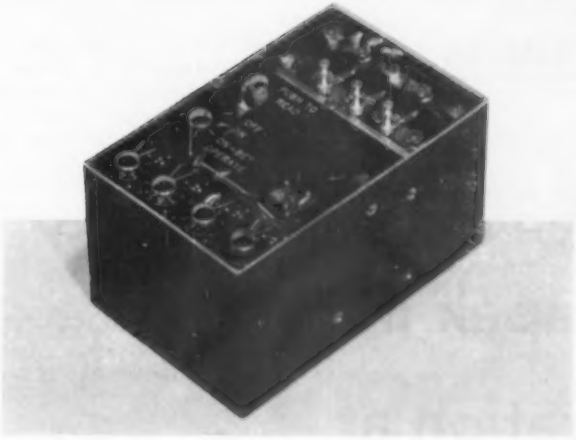
Oscillator pulse frequency is used as a base; the decade counter totals the number of pulses produced over a period of time. An output signal is produced upon the accumulation of a predetermined pulse count. The latter is determined by the desired time interval.

The output signal can be either a



FABRICATION of welded 5-stage ring counter (left) with high-voltage (200 vdc) readout. Component density, says Minneapolis-Honeywell, is 225 parts/cu. in. Counter is used in new 50-hr. magnetic-core timer developed for Army (Right) Finished timer—size: under 1 cubic inch.

e, High Accuracy



COMPLETE TIMER package provides time-base magnetic-core oscillator, welded circuitry for countdown, "time-remaining" readout, final output, and battery power supply. Unit weighs under 1 lb., occupies 35 cu. in.

momentary high-current pulse derived from the timer power supply or a solid-state switch closure. The latter could be used to control some external function.

Variations in time-interval length are practically unlimited, since oscillator frequency and pulse count used to produce the output signal can be selected at the time of manufacture.

Also, Honeywell indicates that where sequentially occuring events demand accurate programing, interstage output leads from the decade counter can be used to provide intermediate timing pulses prior to final output pulse.

• **Design characteristics**—Honeywell engineers feel that elimination of crystals or mechanically resonant devices normally used to generate the time base produces a device capable of withstanding unusually severe shock and vibration environments.

They indicated that it is conceivable that such a device could experience an impact so intense as to alter the characteristics of the saturable magnetic core.

However, magnetic timers have been subjected to shock levels as high as 4000g with negligible effect on core characteristics.

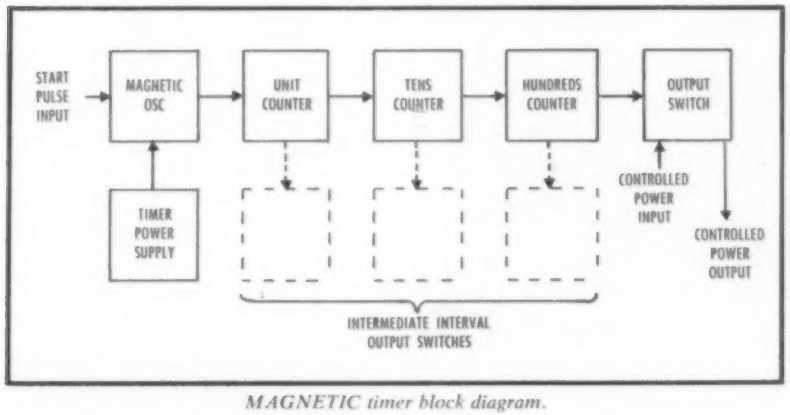
The timers reportedly meet all standard MIL spec vibration test requirements with ease; centrifugal forces at spin velocities encountered in gun-fired projectiles cause only negligible effect on timer accuracy.

• **Power needs low**—The magnetic oscillator operates at a very low pulse rate: thus, in a 5-sec./cycle interval timer, countdown stages are not required. Only a few would be required for longer interval timers. Because of this, power requirements are considerably lower than those required by higher-frequency crystal oscillators using many stages for the same time-out interval.

Honeywell states that a typical 5 sec./cycle magnetic oscillator uses 8 milliamps at 6 volts. Each additional decade counter stage would increase this by 1.5 milliamps at 6 volts.

Such timers can be packaged within a volume of 1 cu. in. Each added decade counter stage requires another cubic inch of space. (A 100-sec. interval timer can, says Honeywell, be encapsulated in a total volume under 3.4 cu. in., or roughly 1.5 in. on a side.)

• **Reliability high**—With its package density, solid-state circuitry and small number of components, the timer is believed to provide inherent high reliability. This is further increased by the use of components in an on-off low-power dissipation mode.



MAGNETIC timer block diagram.

DOFL is now conducting paper reliability studies, but has yet to report any results.

Honeywell is now performing life studies of its units. One has been operated so far for over 2 weeks, with total frequency shift stabilized at an accuracy of 0.04%.

Results are not yet available from DOFL's long-term environmental stability tests. These should be completed by mid-August.

• **Packaging**—Component density in the Honeywell timer is equal to 225 parts/cu. in., the company says.

New techniques in vapor deposition have greatly aided the fabrication of these devices. In one six-stage ring counter, company engineers have deposited 38 resistors on a single substrate. Prior to this, it is believed the largest possible number was eight.

Although somewhat less accurate than crystal oscillators, the Honeywell units are believed to be more rugged. They are considered equal in other respects to timing-fork types, but capable of withstanding higher vibrational effects.

• **Applications**—In addition to their potential as satellite or missile programers, and as fuzes for torpedoes, mines and artillery, the magnetic timers could have hundreds of other applications, in Honeywell's opinion. It is for this reason that the company is going ahead with set-up of new production facilities.

For, beyond the standard uses in timing and programing, the company foresees an equally broad use for its device in integration—some parameter with time.

All that is required is a suitable variable d-c voltage to apply to the magnetic core. For example, the d-c output from a temperature sensor could be used to vary the output as a function of temperature. The timer thus would function as a time-heat integrator.

Similar functions are possible with output from strain gages, accelerometers, or other sensors. ⌗

Biggest Dynapak in Operation at Brake Shoe

Company bids to advance in forging work; costly metals formed in intricate shapes

AMERICAN Brake Shoe Co. is moving to strengthen its position in the aerospace forging market through high-energy-rate forming processes.

Metallurgists at the firm's research center in Mahway, N.J., are conducting a series of forming experiments on the world's largest Dynapak vertical metal-working machine.

The machine is capable of forging, extruding, compacting and blanking. Brake Shoe has used it successfully to shape tungsten, molybdenum, titanium, columbium and zirconium.

The firm is primarily interested in forging and compacting applications, but a pit has been constructed beneath the machine to permit limited extrusion experiments as well.

The high-energy-forming Dynapak was developed by Convair, division of General Dynamics (M/R, April 25, p. 37). Its operation is based on the principle of pneumatics. One chamber holds nitrogen gas at high pressures. When the machine is cocked, low-pressure gas in a second chamber holds the working piston against an orfice plate.

A seal in the piston face isolates from the high-pressure gas all of the pistons surface except the small area surrounded by the seal. With the high-pressure gas acting on the small area, and the low-pressure gas pushing against the larger area, a balanced condition is achieved. Triggering upsets the balance by adding slightly more pressure on the high side. As the piston starts to move, the seal is disengaged and the entire surface of the piston is exposed to the high-pressure gas supply.

A die, or punch, is mounted on a ram attached to the piston. The other die is located in the bolster. The ram smashes into the workpiece at speeds up to 200 ips. Recocking involves a hydraulic system.

• **Sock absorption**—Dynapak has a self-reacting system, similar to that used in artillery recoil. This eliminates dependence on large foundations. When the piston is released, the heavier cylinder and tie rods move slowly in the opposite direction.

The huge machine at Brake Shoe is held in place with a few bolts embedded in concrete. Installation was as simple as putting in a large drill press.

Only a small percentage of Dynapak's power is used in Brake Shoe's hot-forming experiments—35,000 ft. lbs. of the machine's maximum 431,000 ft. lbs. of energy.

A cone-shaped piston cap was formed from a 2-x-2 in. cylindrical billet of 4130 steel. The billet was first heated to 2150°F in a salt bath. Both dies sections were lubricated with a graphite and water solution to cut down heated to 2150°F in a salt bath. Both die sections were lubricated with a graphite and water solution to cut down the possibility of the hot-forged part sticking to the punch or dies.

This part was Dynapak-formed with a wall thickness of 0.180 in. and a variation of ±0.0005. Concentricity value was ±0.010. The surface finish was superior to that achieved through conventional forging methods.

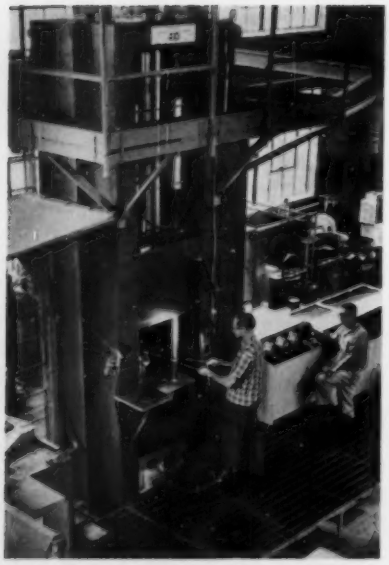
Ordinary forging practices would demand at least four press strokes and a session on a cold-trim press. Inside and outside machining would be required.

The large Dynapak proves most effective where high-cost metals must be formed in intricate shapes to extremely close tolerances. The high abrupt pressures formed within the die cavity cause severe deformations, moving the metal farther and faster than conventional processes. Tough, brittle materials exhibit a plastic behavior and flow smoothly into every die opening.

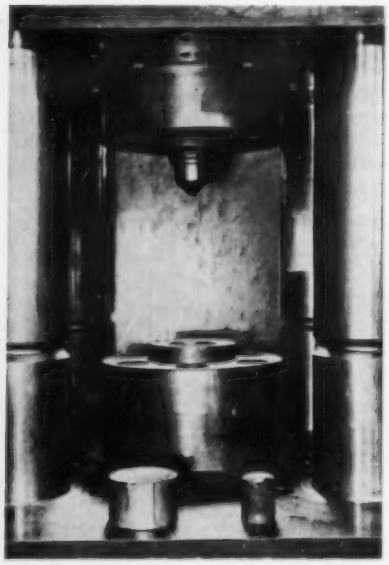
• **Productivity low** — Production rates of several hundred per hour have been reached on standard equipment. The productivity of Brake Shoe's Dynapak is restricted to its cycle time of 105 seconds. This time can be reduced considerably through a few minor modifications in the design.

The potential of Dynapak has not yet been fully determined, and present die design poses another limitation—many conventional dies do not take full advantage of the Dynapak's capability.

Brake Shoe spokesmen feel that the increased forging costs due to short run requirements would be compensated for by reduced metal costs—elimination of much, if not all, final machining—and longer fatigue life. ¤



LARGEST Dynapak in existence is ready for production orders after months of experimentation by Brake Shoe scientists.



LEFT billet here was used in forming of steel-mill oxygen nozzle, right billet for 4130 steel piston cap.

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How ARGMA Estimates Weapon Trends

Technique shows progress within a given system, awarding success where incomplete rounds attain major objectives—no 'partials'

by
A. Steinberg, E. L. Bombara and S. M. Jacks

Army Rocket and Guided Missile Agency, Huntsville, Ala.

THE ARMY Rocket and Guided Missile Agency relies on estimated reliability trends to keep track of how its weapons systems are developing toward their defined objectives.

In terms of success and failure, such trends can be a useful tool—even though the term "failure" is distasteful during a development program.

Mere scorekeeping helps to define problem areas of weak designs in subsystems, out-of-control conditions in manufacture, and human factors contributing to mission failure.

But scorekeeping alone does not produce sound reasons for design changes—it is historical by nature.

For example, when a system fails, the subsystem causing the failure can usually be identified—but it is normally impossible to determine which piece or part caused the failure.

The method of reliability trends outlined in this article should be used to show progress within a system, not to estimate specific system reliability or to compare reliability of one system with that of another.

Techniques for conducting missile-system development programs matured during the last decade. Early in this period, it appeared that a system's firing tests alone were being used to qualify design and laboratory environmental tests, and that other reliability tests were delayed in the all-out effort to launch a vehicle.

Many attempts were made to evolve a method of evaluating system test results to determine system reliability. The problem was compounded by the nature of the products tested—neither homogeneous nor of a statistical quantity.

At the end of these studies it was concluded that:

—Though the test specimens are heterogeneous, there are methods for gaining some system reliability data from small sample sizes.

—A failure must be charted as a total failure, as in statistical quality control, if a figure of fraction-defective is to be offered.

—Until a cumulative average of a large number of successes is attained from homogeneous test specimens, any success/failure ratio must be explained as a point on a reliability trend curve, not as an achieved reliability. Because design configuration changes during a development program, this figure cannot be interpreted as a specific reliability value.

• **Success defined**—A development round is a complex device that seldom has the configuration and model of the final tactical version. Even more complicated is the design of the system's test. The purpose of the test may be to demonstrate safety of explosive components, structural strength, aerodynamic stability, guidance control, or simply to determine levels of shock and vibration. If each round is graded against its own test objectives, no comparison between rounds is possible. But the reliability of the system is defined as the probability of fulfilling its mission—the only ultimate yardstick for grading.

In order to maintain continuity during the evaluation, the scorekeeping criteria are the same for all rounds in the program, even though the design configuration is heterogeneous. Sample sizes would be too small during development if only homogeneous rounds were used to establish trends. For incomplete rounds, a success is awarded if the major objective is attained, even though no opportunity existed for a test of miss-distance, kill-probability, flight control and like parameters.

A major test objective is that of subsystem performance and reliability. Minor objectives such as performance of telemetering equipment and fail-safe circuits are of no concern in determining success or failure, since these components are not to be part of the tactical vehicle.

For development tests, a tactical hold is not scored, although it is a reason to assign failure in a test of troop firings. A misfire or hangfire is a failure; the same round, if undamaged or repairable, can be scored more than once if tested again.

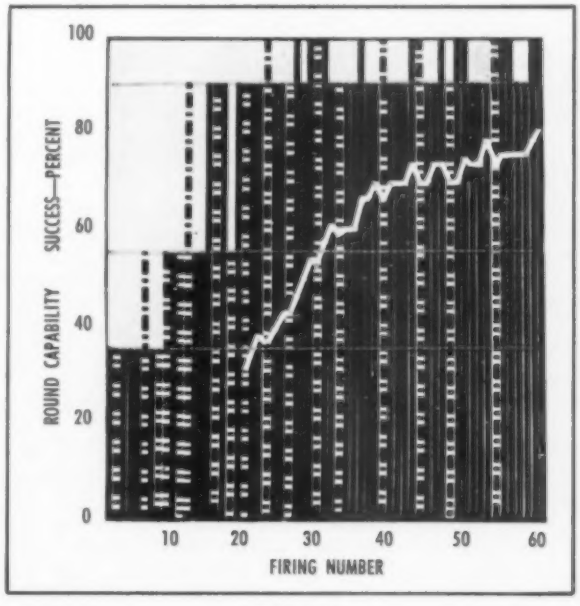


Figure 1

In many cases, success is a matter of judgment. Even with a miss-distance criterion, a miss within the range of the accuracy of the miss-distance measuring equipment is considered a success.

A "partial success"—that is, failure to achieve one primary objective but success in achieving another—is scored as a failure even with incomplete rounds. If the round does not meet all primary performance

test objectives, it must be scored as a failure.

• **Fair weighting**—Since "partial success" is ruled out, an equitable weighting system must be used to estimate system reliability. Without weighting (multiplying by a number less than unity), the first test, being airframe and propulsion only, would usually indicate a system reliability much higher than the completed system is capable of achieving.

If reliability of an incomplete system is not weighted, 100% reliability is assumed for all untested components, which is unreasonable. Thus, the untested components must be accounted for by some weighting system whenever system reliability is computed for the purpose of showing over-all reliability trends.

Where experience in similar systems is available, the weight for each subsystem is based on the expected failure rate of that system. Then the subsystem which is expected to have the highest failure rate receives the highest weight in the computation of system reliability.

Using this method, any "breakthrough" in reliability of hitherto unsuccessful components is scored more heavily, as a contribution to high system reliability, than are previously successful components. The weighting applies only to incomplete systems.

If the system should be complete for 20 consecutive rounds, weights would no longer affect the reliability trend.

For the most part the decision on weighting is arbitrary, even though it is based on prior knowledge from similar systems. Like success, weighting is a matter of judgment.

A suggested weighting system is:

	Weight	Cumulative Weight
Propulsion	.35	.35
Autopilot	.20	.55
Guidance	.35	.90
Warhead and Fuzing	.10	1.00
Total	1.00	

Using this system, reliability of rounds capable of propulsion only can be no greater than 35%; reliability of rounds capable of propulsion and autopilot can be no greater than the cumulative weight, 55%; etc. Figure 1 illustrates a typical development program. For a time all tests are for propulsion only, and system reliability can be no greater than 35%. When autopilot is added, it can be no greater than 55%. With the addition of guidance, maximum system reliability possible is 90%. Only when the system is complete (after addition of the warhead) can reliability be 100% for the number of rounds tested.

From round 20, a cumulative average of success is plotted based on weighted success (figure 1). A 20-round moving average is selected by compromise. A trend line on a moving average less than 20 shows rather violent movements, whereas a greater number delays indication of immediate reaction.

The desired trend would be one of gradual improvement and a final leveling-off at the capability of the system. In figure 1, this is illustrated as a system reliability with only 3 failures in the last 20 rounds plotted.

Even with the best telemetering, it is seldom that the guilty piece or part is blamed for the system failure. Parts-failure reporting is of little use during R&D testing of entire systems. But failure can be localized to the proper subsystem and the subsystem reliability estimated. This may be charted by a simple bar for each subsystem (Figure 2).

In Figure 2, the weight of the solid bar indicates the percent of success experienced by the subsystem. Note that the bar-chart breaks the guidance subsystem into 2 components, ground guidance and missile guidance. Whenever subsystem reliability is low enough so that any of the component reliabilities for that subsystem is less than 90%, it is worthwhile to show each component on the bar-chart.

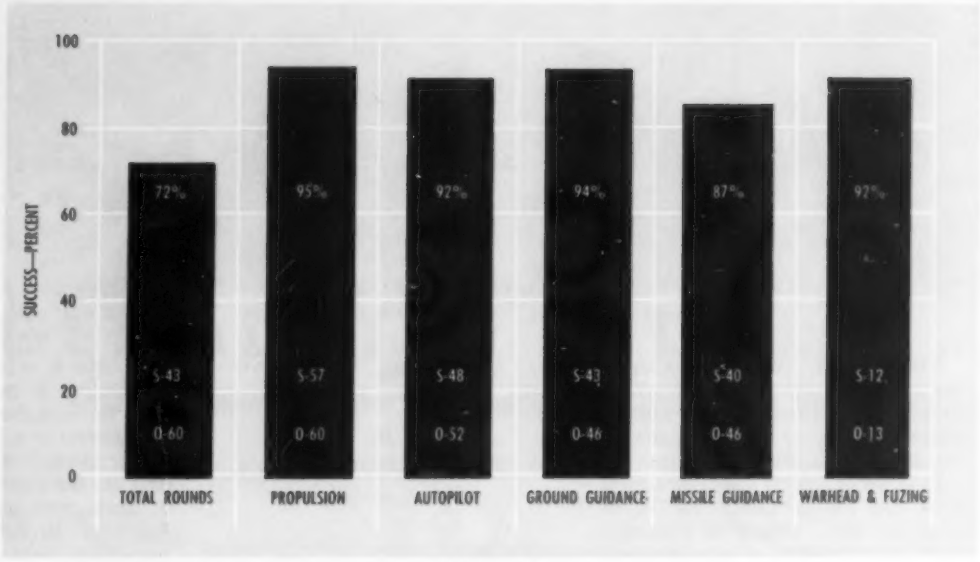


Figure 2

Component reliabilities will always be less than subsystem reliabilities, in accordance with the multiplication theorem of probability: P overall = $P_1 \times P_2 \times \ldots P_n$. The overall system success shown in Figure 2 is 43/60 = 0.72. The 0.81 reliability shown by the last 20-round average of Figure 1 is higher than this because it does not include the effect of problem areas that have been solved. Thus, the 20-round moving average is more meaningful.

Under the ARGMA method of scorekeeping, all systems tests are graded as success, failure, or no test. A success is defined as the achievement of the objectives of the tactical weapon, or as success of the primary test objective if the system is incomplete. Incomplete systems are weighted according to the importance of subsystems to the mission. A system trend based on a 20-round moving average is plotted after 20 test results are available. ⁂

First Minuteman Titanium Rocket Chamber Passes Test

THE FIRST second-stage titanium rocket chamber for the Air Force's *Minuteman* ICBM has been produced and hydrostatic-tested by Avco Corp.'s Lycoming Division, Stratford, Conn.

The unit is believed to be the largest rocket chamber ever fabricated of titanium and successfully hydrotested, Lycoming says. It was manufactured under a contract from Aerojet-General Corp., contractor for the second-stage *Minuteman* engine. ⁂

An Optical Sensor for Super Gyros

OPTAG I, developed by Perkin-Elmer, uses autocollimation technique for sensing gyro precession; spillover problem overcome

A HIGHLY EFFECTIVE solution to the problem of precession pickoff on exotically suspended spherical rotor gyros has been developed by the Perkin-Elmer Corp.

Developed for use with magnetic, electrostatic, air-suspended or other types of super gyros, the new device—nicknamed OPTAG (for Optical Pickoff Two Axis Gyro)—eliminates through use of the principle of autocollimation the inaccuracies inherent in standard electrical precession pickoffs.

• **Development**—OPTAG I—an extremely small two-axis, null-sensing autocollimator—was developed for specific application to an air-bearing gyro mounting a flat mirror on its rotor normal to the spin axis. It resulted from a company-sponsored program initiated early this year by Perkin-Elmer.

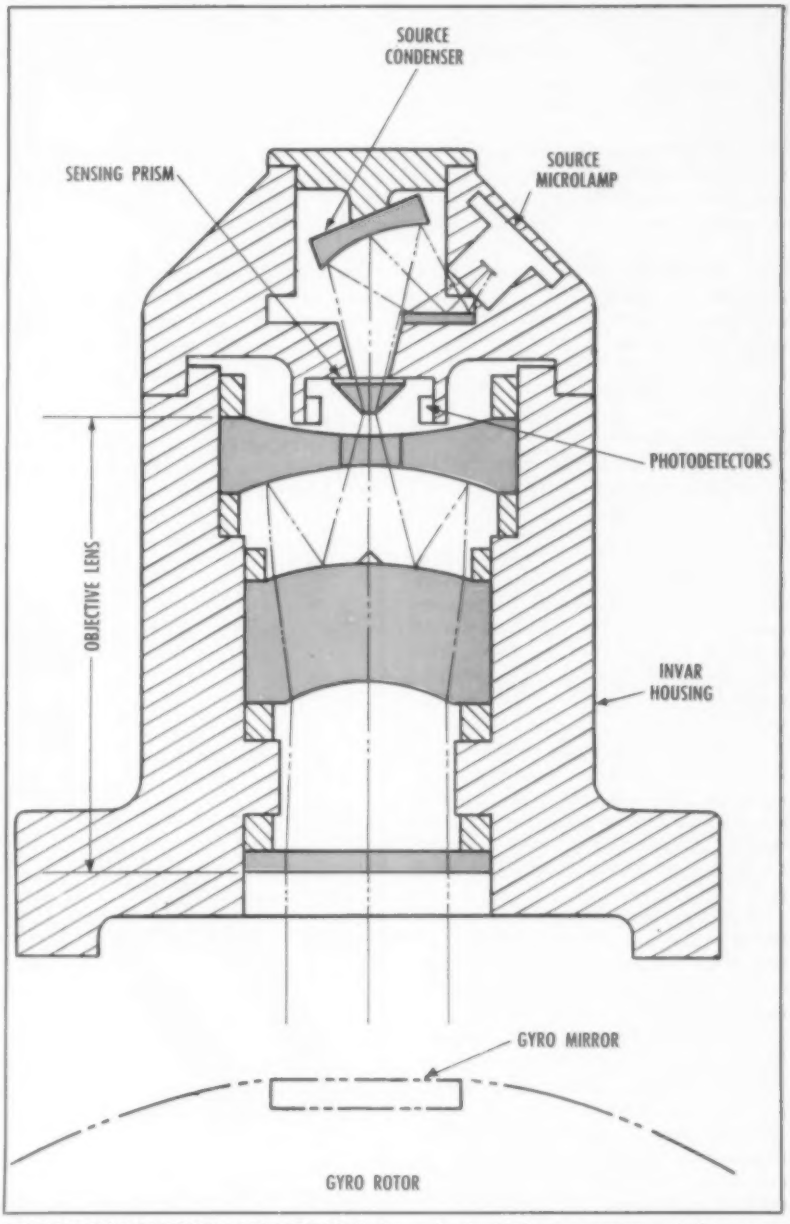
Although this particular optical device has an air-bearing application, company officials point out that it can be adapted to other super gyros.

Development of the system required a pickoff that produced little reaction force on the gyro rotor, was compact, lightweight and long-lived, and consumed minimum power.

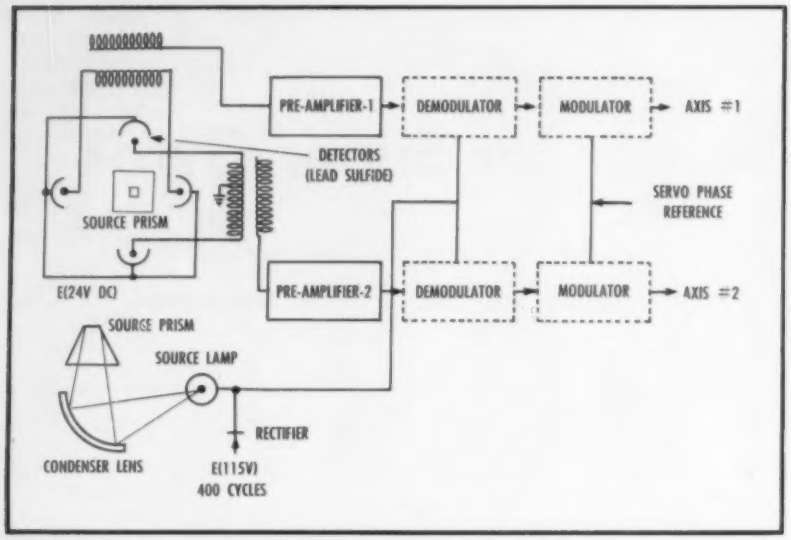
• **Functioning**—In operation, OPTAG I meets these requirements by sensing light improperly superimposed on the nose of a prism and feeding these error signals to the torquing motors of the gyro gimbals.

Specifically, the light from the lamp filament is imaged from behind on the clear nose of the sensing prism. The nose—focused at infinity or collimated by the objective lens—senses the autocollimated light reflected from the gyro mirror.

If the mirror is not precisely normal to the optical axis, the re-imaged light will be imperfectly superimposed on the nose. Some light, therefore, will fall on the sides of the sensing prism and be reflected into one or two of the servo detectors. The resultant error signals—amplified and applied to the torquing servos of the gyro gimbals—serve to maintain the alignment of the gyro case with the rotor.



CUTAWAY DRAWING OF OPTAG I shows in detail the components of the system which—using autocollimated light—provides an accurate, reliable means for monitoring precession of the most advanced gyros presently under development.



SIMPLIFIED ELECTRONICS can be achieved if the gyro and detector frequencies are identical. However, if d-c voltages or a frequency different than that of the gyro circuits are required, demodulators (or remodulators) can be used as shown.

• **Design problems**—To establish the validity of the OPTAG design, four interrelated, overlapping problems had to be investigated:

—Radiometry
—Optical Design
—Optomechanical Design
—Electronic Design

Because of OPTAG's requirements for small size, low power consumption, long life and long term stability, radiometry was clearly most critical.

Generally, an autocollimator with only one light source and two detectors for each measuring channel can be constructed. However, since the light source is also the largest, least reliable, and heaviest power source, the optimum design for OPTAG was a single source and four detectors.

• **Solid-state detectors**—The physical size of the OPTAG dictated the use of solid-state lead-sulfide photodetectors. Compatible for use with a derated tungsten filament lamp, these detectors are both standard and available in small sizes.

However, the use of lead-sulfide detectors demanded reflective lens, to provide good imagery and high transmission over the 0.5 to 2.5 micron detector sensitivity region.

• **OPTAG sensitivity**—Radiometric relations in an autocollimator are normally directly proportional to the objective lens aperture and the field angle of the light source. However, since the objective lens aperture is dictated by the gyro mechanism, the instrument sensitivity becomes solely dependent upon the source field angle.

Thus, by carefully selecting the field angle, instrument sensitivity can essentially be determined. There is, however, a limit to the gain which can be achieved by increasing the source field angle; sensitivity of the OPTAG falls off rapidly as the angle is increased above five degrees.

By fixing the source field angle at 2.5 degrees, an instrument sensitivity of better than one arc-second is achieved. This fixed angle, however, causes the source height and the objective lens focal length to be interdependent.

• **Desirable focal length**—To maintain a constant source field angle or instrument sensitivity, the source image size must increase as the focal length of the objective lens increases.

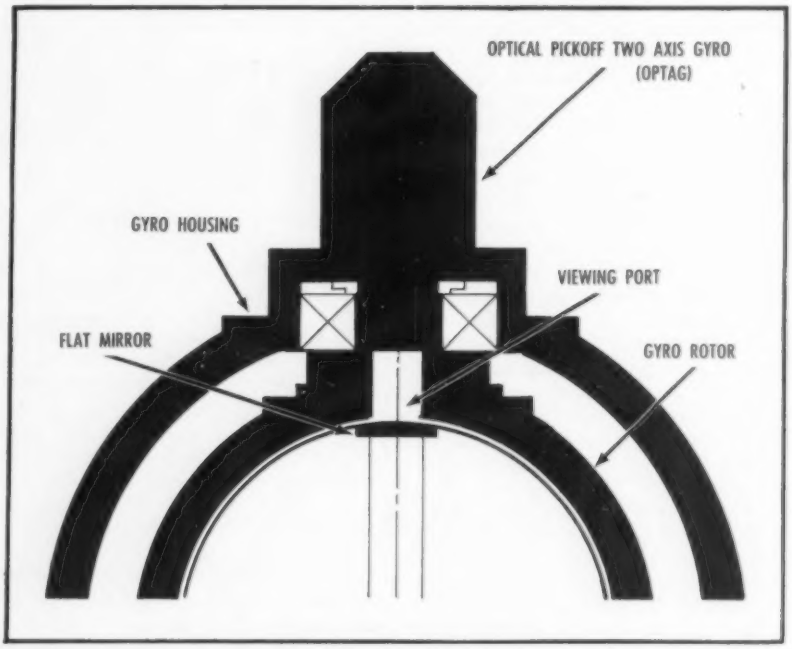
In order to achieve maximum system sensitivity, therefore, the objective lens must be of short focal length and high speed (in order of f/2.0).

With an f/2.0 objective lens and a specified clear aperture of 0.30 in., a focal length of 0.60 in. is called for. This, in turn, along with the 2.5 degree source field angle, necessitates a 0.028 in. height for the source lamp.

• **Source lamp**—Consisting of four sections of coiled tungsten filament wire arranged to form a square slightly larger than the sensing prism nose (to prevent light discontinuity), the lamp filament is wound in a flattened manner. This provides the maximum amount of unidirectional radiant energy per unit of length.

The lamp—with a power input of approximately ⅜ of a watt—operates at a color temperature of 2150°K which makes it compatible with the spectral sensitivity of the lead sulfide detectors.

• **Spillover problem**—Because of the large angular diffraction pattern of small-aperature automatic autocollimators, many seconds of light energy spill over onto the detectors at the null point.



THE OPTAG OPTICAL AXIS—mounted normal to the gyro spin axis—need only maintain a fixed angular relation to the case. This is accomplished through a Bellville spring-clamped three-point kinematic base, which maintains the angular relationship while permitting sliding between the OPTAG and gyro case.

The effect of this spillover is to make the autocollimator susceptible to null shift.

Taking into account the aperture diffraction pattern and the lead-sulfide detector characteristics, 24 seconds of light should still be incident on each detector when the OPTAG is perfectly autocollimated. This null-balanced light results in a 1.2-sec. null shift—a 10% change in reflective detector sensitivity—and also increases OPTAG instability.

To limit this instability, a highly refined lens design is needed to provide diffraction-limited imagery over the spectral region of interest. The only lens that meets this requirement and, at the same time, satisfies the field angle and f/2.0 speed, is a special flat-field Schmidt Cassegrain Catadioptric design.

• **OPTAG housing**—The necessity for long-term OPTAG stability dictated that the low expansivity quartz optics be housed in a temperature compensated cell.

Mounted in an Invar housing which has a coefficient of expansion close to that of quartz, the objective lens and sensing prism are located according to kinematic principles. Incorporating five-point mounting, these elements utilize controlled spring loading in all directions.

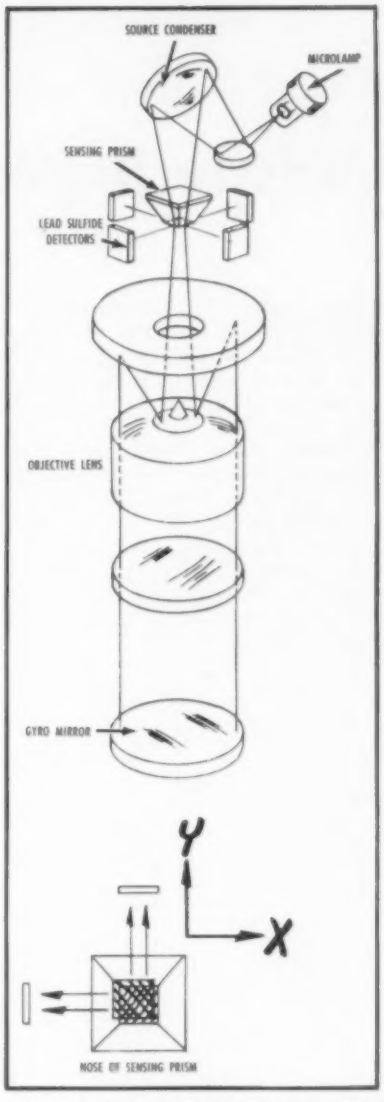
To maintain all elements in-line over a wide range of operating temperatures, the difference in expansivity between the Invar housing and the quartz optics is compensated for in the radial direction.

The difference in expansivity between the housing and the gyro case must also be compensated for. However, because it is an autocollimator, the OPTAG optical axis need only maintain a fixed angular relation to the case. This is effected by use of a Belleville spring-clamped three-point kinematic base. This permits sliding between the housing and the case but prevents angular motion between the two.

• **Electronic design**—Modulated light received from the detector causes an a-c signal to be applied to the amplifier. The opposing detector also produces an a-c signal at the same amplifier. However, because of the center-tapped transformer, the phase of this signal is reversed.

If it is practical to operate the OPTAG at the frequency of the gyro gimbal torquing servos, only the simplest followup design is necessary. Modulation of the light source from a line-energized half wave rectifier, thus obtaining a fixed phase relation between the servo reference voltage and the light source error signal, reduces the electronics to simply the lamp driver and the detector preamplifiers.

However, if the OPTAG carrier must be different than the servo frequency, or if DC is required, demodulators (or remodulators) would be necessary after the preamplifiers.



LENS SYSTEM of OPTAG I focuses light on the nose of the sensing prism and detects errors through shifts of autocollimated light. Typical error pattern—picked up by sensors—is shown at bottom of sketch.

• **Testing program**—Testing of OPTAG I began before the special tungsten light source had been completed. However, use of a mechanically chopped ribbon filament and an external mirror to provide an f/2.0 bundle, made the test setup optically equivalent to the final OPTAG I configuration.

Revealing a high level of sensitivity, the system had a resolution of better than .05 arc-seconds RMS with short-term stability of better than five seconds.

The main problem, previously discussed, was the spillover light. Measurements of the detectors at null revealed that each detector had 90 seconds of incident light instead of the prescribed 24. However, stray light—traced to the sensing prism geometry—contributed 60 seconds of light even when the autocollimated beam was blocked off.

By reducing the included angle of the prism to 80° instead of the present 90° and placing the detectors closer to the base of the prism, this problem can be solved.

• **Follow-on program**—The next version of this system—OPTAG IA—will use an f/6 objective lens and an OPTAG I source lamp and will afford a source field angle of less than one degree. The smaller field angle will allow the use of a simpler, more economical Mahsutow objective lens. Since little attention was paid to the size of OPTAG I, it is expected that the second-generation device will be smaller and lighter than the one-in.-diameter, one-and-three-quarters-in. long, nine-ounce OPTAG I.

OPTAG I was revealed at a Symposium on Optical Alignment Instrumentation sponsored by the Electro-Optical Division of Perkin-Elmer. A paper describing in detail the operation of the device was read by Sheldon Minkowitz of Perkin-Elmer. ⌗

U.S. and Britain to Build MIDAS Station in England

THE UNITED STATES and the United Kingdom have agreed to establish a MIDAS (Missile Defense Alarm System) read-out station in Northern England to give the British faster warning of an ICBM attack.

The United States has agreed to pay about $28 million of the cost of the installation, to be built at the Kirkbride RAF Station in Cumberland. Britain will provide the remaining $5.6 million to $8.4 million.

The USAF's MIDAS infrared satellite warning system, for which Lockheed Aircraft Corp. is prime contractor, will complement BMEWS (Ballistic Missile Early Warning System) in Britain's defenses. A BMEWS station is already being constructed in Fylingdales, Yorkshire.

Julian Amery, Britain's Air Secretary, told the House of Commons that the MIDAS station should provide six minutes' warning, compared with the four minutes expected from the BMEWS radar. He emphasized that the warning times in both cases were based on the worst predictable circumstances.

The U.S. will supply and install the special equipment for the Kirkbride station and its communications link with America. Britain will provide land, housing, communications equipment and pay for spare parts. ⌗

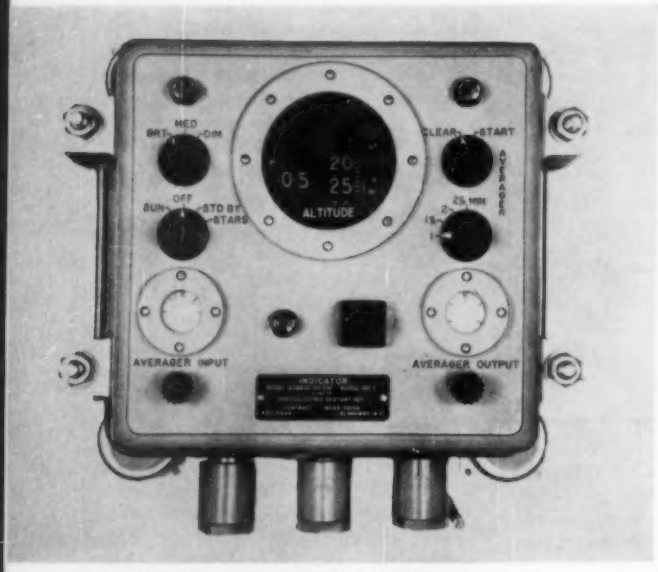
Device Seen Vastly Improving Accuracy

Kollsman scientist says use of modified aircraft tracker can yield order-of-magnitude advances; details of system

WILLIAMSBURG, VA.—Skippers navigating submarines at periscope depth could improve their accuracy by an order of magnitude by taking celestial sighting with a modified aircraft automatic tracker.

Simple analog compensation techniques can minimize the problems of periscope flexure without elaborate instrumentation.

Both the measurement technique and equipment which will do the job were described by Louis Sharpe at the annual meeting of the Institute of Navigation, held here recently.



COMPUTER-INDICATOR of Kollsman KS-100 is installed within the submarine.

Sharpe, chief of astronavigation R&D for Kollsman Instrument Corp., described the workings of the KS-100, semi-automatic Photoelectric Sextant for submarines. He described it as essentially a modification of the Kollsman KS-85 star tracker carried in the Air Force's B-57 jet bombers.

The instrument compensates automatically for hull rocking and periscope bending. Further, Sharpe said, the device can be designed to provide relative bearing measurements for true headings.

Although results are still highly classified, the KS-100 has been successfully tested aboard the Navy submarine USS Barbel.

• **Sighting an old problem**—In achieving the great accuracies needed by submarines on underwater missions, a major problem is always evident—the remoteness of sighting optics.

The problem, Sharpe disclosed, is that the stellar light (whose direction is the object of measurement) enters an optical system located just above the ocean surface. The best location for such a system would be within the hull of the boat for an inertially established vertical. It is against this vertical that stellar direction is measured.

To counteract motion atop the periscope, a gyro-stabilized platform could be employed—were it not for its prohibitive size. The method used is to bring the star direction down the scope and into the boat. There is a coordinate rotation operation, however, between deck and horizontal planes. And periscope bending action must still be counteracted.

• **Kollsman's approach**—Sharpe believes the KS-100 approach is the best and simplest answer: Locate the automatic sextant on top of the periscope and employ averaging techniques instead of stabilization. In short, Kollsman would automate the measurement-flow equivalent of a manual sextant sighting process.

Automatic star and vertical trackers would develop angles between their respective sensor directions and the instrument case. Data obtained would be star elevation-to-case and dynamic vertical-to-case (tilt measure). The difference between elevation and tilt is star altitude.

The indicated summation of sensor angles provides a result, Sharpe said, similar to the manual-sextant coincidence-sighting technique.

Tilt is effectively cancelled (the star is sensed by both trackers equally) and the altitude measurement resulting is unaffected.

As for vertical reference, he feels that periscope tilt in line with the star target can be tolerated. But, tilt components perpendicular to star direction (cross tilt) will be excessive and their influence will have to be eliminated. Thus, he said, the value of cross tilt must be measured, as well as that of in-line tilt.

• **Tracker design and operation**—The configuration of axes needed (see accompanying drawing) can be packaged within periscope diameter limits.

Sharpe said the tracker consists of the scanner combination of optics, modulator and sensor together with supporting axes of elevation and bearing. To null the scanner on its particular stellar target, pointing error signals developed by the scanner are amplified and used directly to re-orient the supporting axes.

Tilt-level sensors develop signals used to restore the corresponding axis and

# of Submarines' Position Fixing

null its sensor. Sharpe said the level-sensor assembly, is, in effect, a miniature level platform with the characteristics of a damped pendulum.

Platform azimuth orientation is determined by the bearing axis, since it is shared in common with the celestial tracker.

With the KS-100 axis geometry, the engineer believes, it is possible not only to represent fairly precisely the influence of cross-tilt on celestial altitude, but to compute it simply by electromechanical means. (The quantity is equal to the square of the angle on cross-tilt axis times the tangent of the altitude registered at the output counter.) Normal potentiometer precision is sufficient, said Sharpe, since the actual value is never large for practical cases.

The only precision necessary, he feels, is in directing the star and vertical trackers. Subtraction is done simply by a differential geared to operate at multiple speed. The only trigonometric computation is the cross-tilt compensation—and this contribution is small and easily instrumented.

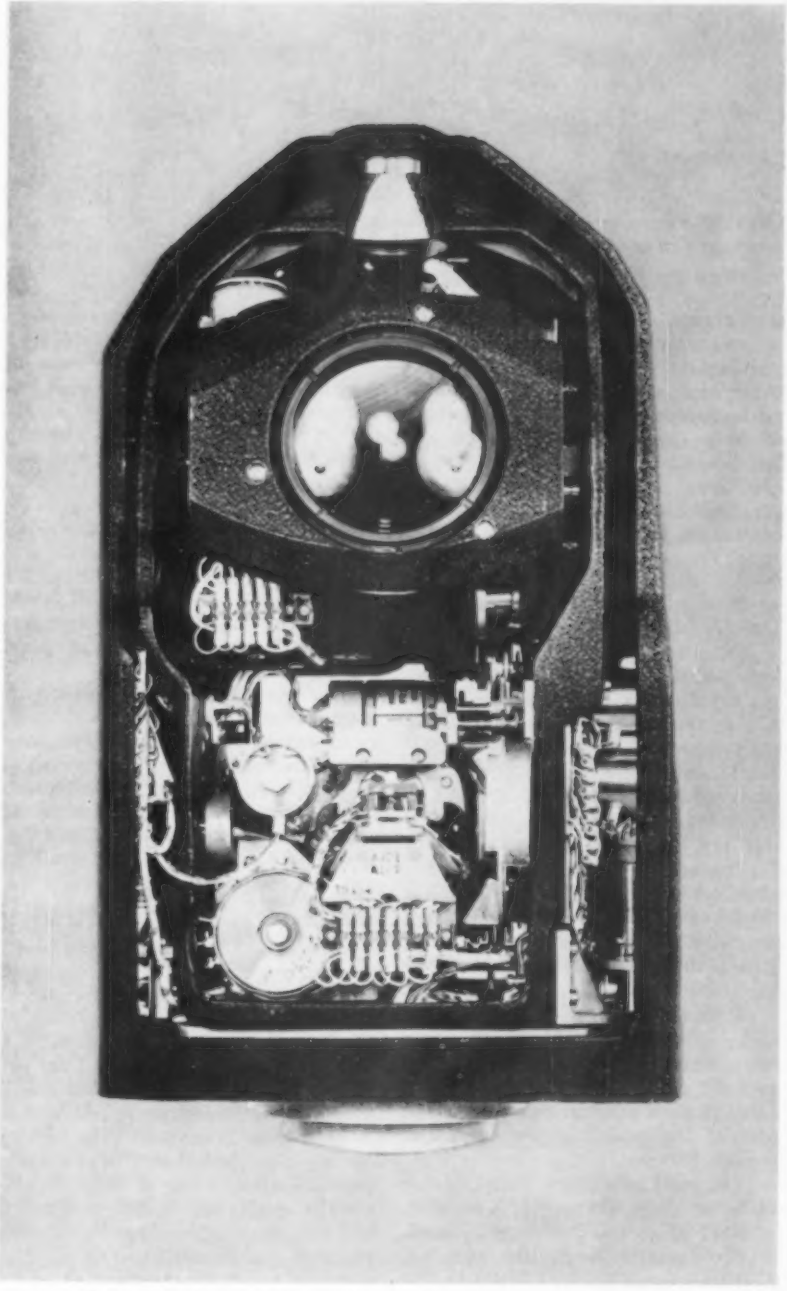
Therefore, Sharpe asserted, by combining techniques of in-line tilt cancellation and the cross-lit compensation, a periscope-mounted sextant can operate satisfactorily within the tilt conditions of its flexible support.

• **Averaging for accuracy**—for submarine use, Sharpe said, automatic celestial sightings will reflect deviations from true local vertical as high as 42.2 minutes of arc, under conditions of a state-3 sea.

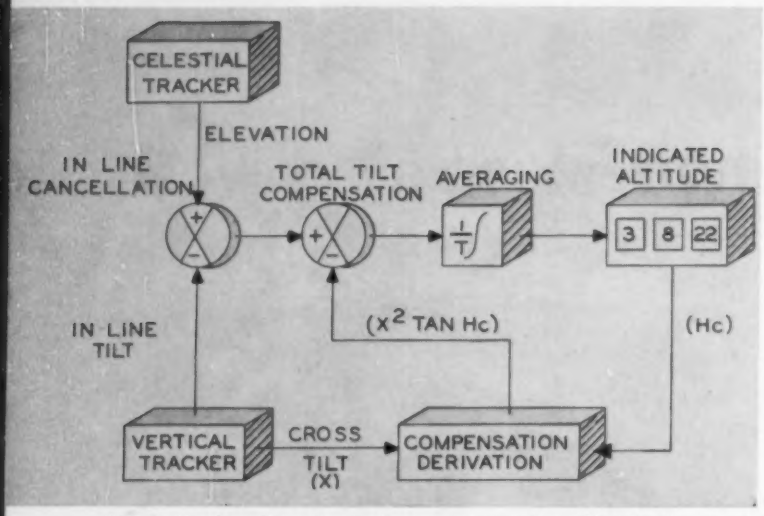
Some form of smoothing is necessary to prevent an accumulation of errors from the altitude output counter. While highly sophisticated methods of smoothing observations might be employed, Kollsman believes the simple approach to be more profitable.

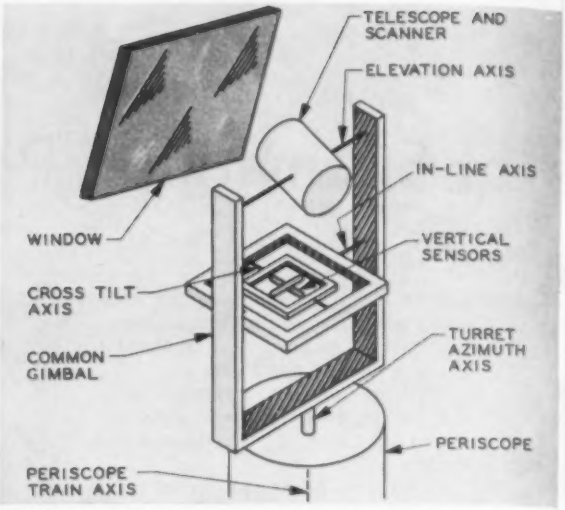
For remote averaging of celestial altitude angle, Kollsman employs an integrator that is essentially a form of tachometer servo. This unit, in the follow-up mode, keeps the output counter almost up to correspondence with the varying transmitted celestial altitude. Ideally, response is slow enough to prevent repetition of sudden variations in altitude.

Averaging completely screens out



TRACKER OF KOLLSMAN KS-100 shown with outer turret removed. The automatic photoelectric sextant was designed for use atop submarine periscopes for star tracking. Its developers say it may improve position-fix accuracy by an order of magnitude.





LEFT: *Configuration of axes for an automated tracking head. Such a system can be used to measure both cross-tilt and inline tilt for error compensation.* **RIGHT:** *Flow diagram of automated sextant providing tilt compensation, averaging of observations, and readout of computed stellar altitude. The Kollsman system has been checked at sea aboard a Navy sub.*

only certain types of variations—such as an integral number of sinusoidal cycles—said Sharpe, and remaining phase error experienced will possess a random value. However, the rms error resulting from averaging weaknesses can be calculated for a given set of conditions.

If the navigator fits his averaging interval to sea motion within ¼ roll cycle, Sharpe reported, error is reduced to 44.1 sec. of arc. The better the sea state, the more effective is the averaging process.

There are two other non-cancellable error forms, according to Sharpe, that can be eliminated by conventional sextant routines: acceleration of Coriolis and real changes in true value of celestial altitude (caused by motion of observer and earth rotation).

The first, Sharpe asserted, is predictable and thus can be computed out.

The second has change rate and constancy slow enough so that its effect can be cancelled merely by designating the center of time interval in computations as that instant for which the average value is valid.

• **Magnitude improvement**—Together with the automatic sightings, tilt compensation, and averaging, the use of multiple sightings on other stars well distributed in azimuth can provide an order-of-magnitude improvement in position fix.

The point stressed by Sharpe is that while the navigation concept is not new, its order of accuracy is unprecedented.

For example, when four stars are used for a quadrilateral of position, the figure center represents a fix whose standard deviation in latitude and longitude is reduced from a single rms by a factor of 0.875. Furthermore, index error is nearly cancelled, Sharpe said.

The KS-100 hardware consists of three separate subsystems: the tracker, computer-indicator, and control amplifier. The tracker, contained within a rugged turret, was tested as a part of a Kollmorgen Optical Co. Type 10 periscope.

Size-weight details of the KS-100 have not been released. However, as a rough indication of vital statistics, the earlier aircraft version (KS-85) employs a 16.5-lb. tracker, and measures about 7.25 in. dia. X 17.2 in. high. Total system weight is 47 lbs.

The tracker is visually assisted by the operator in locating the correct star, since training and elevation are coincident with the periscope cross-hairs.

According to Sharpe, KS-100 real-star performance has been checked on a Scorsby machine (roll, pitch, and yaw simulator) and at sea aboard the USS Barbel. Tests apparently have been satisfactory, but actual results are classified.

Sharpe stressed five other principal features of the Kollsman semiautomatic photoelectric sextant:

1. Simplicity—in concept, hardware, and computation.
2. Serviceability—tracker can be removed easily at sea.
3. Automaticity—manual skill not required during sighting.
4. Operability—star and vertical sensed at same location; periscope tilt and bend fully accommodated.
5. Practicality—tracker offers small exposure and non-interference with normal periscope functions.

The only loss exhibited by this navigational aid, according to Sharpe, is observation time. With the promise of magnitude improvement in accuracy it would appear to be more than a fair trade. ⠿

'Hardest' Tool Steel in Production

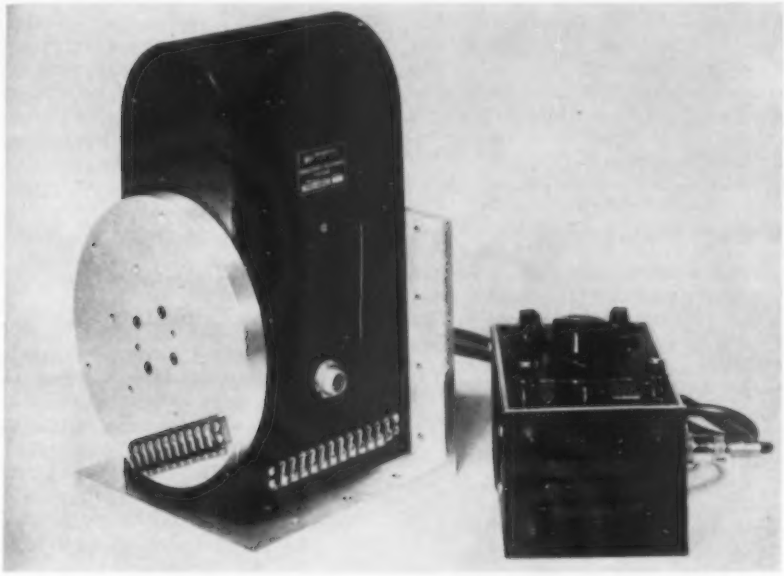
A TOOL STEEL that "approaches the hardness of a diamond" has been announced by Continental Copper & Steel Industries, Inc.

The new high-speed alloy steel, now in commercial production, will cut virtually all other known metals or alloys, according to the company, and in tests by more than 75 companies has kept its cutting edge up to 10 times as long as previous standard tool steels.

The special composition—described as containing chromium, vanadium, tungsten, molybdenum and cobalt, plus a relatively small percentage (1.15%) of carbon—was developed at the laboratories of the Braeburn Alloy Steel Division of C.C.S.I. and introduced last December for testing by the machine tool industry. The company says the price of the alloy is about the same as that of conventional high-speed tool steels.

Mortimer S. Gordon, president of Continental, declared that the material —known as Braecut—will help solve the Space Age problem of machining super-strength metals developed for missiles and satellites.

"Braecut permits machining of the newest tough alloys and steels," he said, "and thus extends the range of metals which can be used in space vehicles, missiles and other applications." He added that the new alloy "radically reduces replacement of cutting devices." ⠿



Gyro and Accelerometer Tester

A frequency response test fixture, Model FR01, has been developed by Humphrey, Inc. The device provides for dynamic tests on rate gyros, integrating gyros and accelerometers. It will perform the same function as complex test equipment at a much lower cost. The test fixture consists of a lightweight, variable-speed turntable built on a precision right-angle mounting base.

Slip rings provide for eight connections from the base to the turntable. A remote control box provides full control. Speed range is from 1 cps to over 25 cps. A switch provided to indicate the position of the table permits phase measurements. A pot may be furnished to supply sinusoidal output in phase with the rotation.

Circle No. 225 on Subscriber Service Card

Lab Electromagnet

A 6-in. laboratory electromagnet is available from Varian Associates. Designated the V-4007-2, the 6-in. magnet features pole pieces of which the air gap width may be continuously adjusted from 1/32 to 5½ in. by means of an integral gap-adjusting mechanism. The V-4007-2 enables scientists to examine samples of widely differing sizes at many desired magnetic field strengths. It reduces the time previously needed to adjust the air gap of 6-in. magnet types. This mechanism can also be added to all Varian 6-in. rotatable magnets in use; and the owners of the new magnet can convert to fixed-pole pieces, if desired, to gain particular benefits of extremely high-field homogeneity.

Circle No. 226 on Subscriber Service Card

Precision Drive

A miniature dual speed drive designated DSD-40 is available from Technology Instrument Corp. Designed to meet the need for a low-cost miniature precision gear reducer, the DSD-40 provides a positional accuracy of 12 minutes of arc. A knurled thumbwheel actuates a screw and axially locks the outer dial securely on exact setting. It may be adapted to any of the precision packaged drives produced by TIC.

Circle No. 227 on Subscriber Service Card

Rectilineal Potentiometer

A rectilinear potentiometer has been introduced by Hyres Electrical Division, Hydraulic Research and Manufacturing Co. Through the use of new materials, stability of the 431 Series is under 30 ppm per degree of C° to 150°C plus operating temperatures from −70° to 175°C. Available with strokes from 0.5 to 12 inches, and mounting configurations of either flange, clamp or collar. Termination is accomplished through the use of Hyres' exclusive leakproof chamber utilizing teflon leads.

Circle No. 228 on Subscriber Service Card

Airborne Transducer

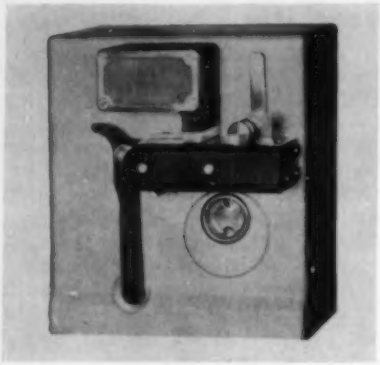
Taber Instrument Corp. is marketing a miniature transducer designed for airborne applications involving the precise electrical measurement of fluid and gas pressures up to 200 psia or psig. Called "Teleflight" Model 183, it is built to withstand the severe accelerations and vibrations encountered during missile and rocket flights, while maintaining pressure-measurement accuracy of 0.25% over a wide temperature range. The measuring element is a one-piece, Ni-Span-C proving ring to which are

bonded four precision strain gages, forming a Wheatstone Bridge. Under zero gravity conditions, when convection cooling ceases to function, the proving ring acts as a heat sink in conducting heat from the resistance wires to the instrument case. Metal diaphragms separate the pressure cavity from the measuring chamber.

Circle No. 229 on Subscriber Service Card

Anemometer Reader

Soroban Engineering, Inc. has developed a Anemometer (hot-wire) high-speed tape reader that offers extreme reliability in high-speed tape reading at varying speeds from static to more than 500 in./sec. The Anemometer sensing elements and the feed mechanism of the Soroban GP-2 tape perforator are in-



tegrated into a single compact unit which will reliably read character-by-character, at speeds up to 300 codes per second. Tape handling is so gentle that even low-grade paper tapes have a life of hundreds of passes.

Circle No. 230 on Subscriber Service Card

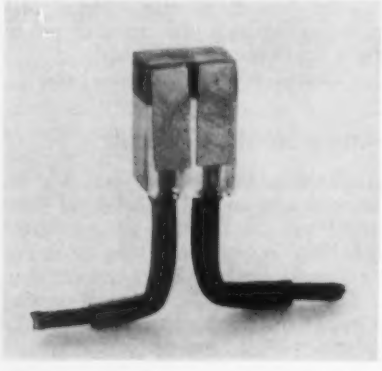
Computer Equipment

A complete line of peripheral equipment for the PB250 computer is available from the manufacturer, Packard Bell Computer Corp., Division of Packard Bell Electronics. All of the peripheral units are designed for plug-in connection to the PB250 without need for accessory equipment or modification. Included in the line are magnetic tape units, a high-speed buffer, high-speed paper tape reader, high-speed paper tape punch, card reader, digital graph recorder, analog-to-digital and digital-to-analog converters, high-speed line printers, and a battery power supply.

Circle No. 231 on Subscriber Service Card

Thermoelectric Modules

Sela Electronics Co. has available the CORON thermoelectric module, whose many uses include cooling or heating of electronic systems and components, medical and laboratory equipment, and compact airborne and under-



water units, as well as reliable maintenance of constant temperature. The units are available in one-, two-, four- and eight-couple modules, in encapsulated or non-encapsulated forms, and exhibit a high figure of merit and exceptional heat pumping capacity.

Circle No. 232 on Subscriber Service Card

Volt-Millivoltmeter

A portable vacuum tube volt-millivoltmeter (model 100), with accuracy within 1% has been developed by Sun Electric Corp. for laboratory and field use. The meter features 12 voltage ranges from 1 millivolt full scale to 300 volts full scale. It also has 12 DB

ranges, −72 to +52 DB full-scale reading out on a 5-in. mirror scale with a knife edge pointer. It operates from either a 115 or 230 volt, 50 to 1000 cycle source and is self-protected to 600 volts.

Circle No. 233 on Subscriber Service Card

Hi-Pressure Storage Vessels

High-pressure gaseous storage vessels have been developed by The Garrett Corporation's AiResearch Manufacturing Co. The storage vessels are designed for operating pressures up to 20,000 psi. Their applications include any high-pressure gaseous use, either airborne or ground. The vessels, made of 4340 steel, have proven reliability—successfully undergoing 100 g shock tests.

Circle No. 234 on Subscriber Service Card

Weld Strength Testers

Weld Joint tensile testers have been added to the line of electronic welding equipment at the Vacuum Tube Products Division of Hughes Aircraft Co. The units are available in two models: the VTA-46, having a testing range of 0-50 lbs., and the VTA-47 with a 0-100-lb. range. Both feature a load indicator which holds the maximum specimen pull until reset. A one-to-one mechanical adjustment of the load jaws make possible quick set-ups, but actual loading is applied through a 100-1 reduction wheel. Other features of the units are a jeweled meter movement, interchangeable jaws and anti-backlash provisions to prevent surge readings at the breaking point.

Circle No. 235 on Subscriber Service Card

Salt-Spray Chamber

A self-contained, automatically controlled salt-spray chamber which assures maximum protection against salt vapors escaping from the chamber's test compartment is available from Wyle Laboratories. Heater and thermostat, which are susceptible to corrosion, have been eliminated from the salt-solution reservoir. The internal test compartment, which encloses the reservoir, is constructed entirely of fiber-glass-resin, in place of materials such as rubber, which are subject to corrosion. A water seal around the chamber's top edge prevents the salt fog from seeping out into either the machinery compartment or the atmosphere.

Circle No. 236 on Subscriber Service Card

Interference Filters

Infrared Industries, Inc. has available a new line of high-quality optical interference filters with band-pass and "spike" characteristics in the spectral region 0.38 to 0.8 microns, extending from near-ultraviolet to near-infrared. Spike filters feature bandwidths of as little as 1% of peak wavelength with 60% or better transmission of center wavelength than the nominal pass band and may be blocked to specification on the long wavelength side to reflect radiation equivalent to the spectral response of an S-4 phototube. Special filters, also available, include extremely wide-pass filters and spike filters with pass bands as little as 0.1% of center wavelength.

Circle No. 237 on Subscriber Service Card

Traveling Wave Tube

A low-noise, K_u-band traveling-wave tube amplifier with a saturated power output of 5 milliwatts is available from the General Electric Co., Power Tube Department, for use in countermeasures equipment and microwave relay systems and as the input tube in radar receivers. Designated the Z-3031, the tube has a noise figure of less than 14 db across its specified frequency range of 14-18 km. Gain is at least 25 db.

Circle No. 238 on Subscriber Service Card

Silicon Power Varactors

A series of 55 high "Q" silicon power varactors with a wide variety of breakdown voltage values from 6 volts through 120 volts is available from Microwave Associates, Inc. These diodes (MA-4351A-G through MA-4358A-F) are said to provide unprecedented high-efficiency harmonic generation and are recommended for applications in the 1 mc to 40,000 mc region. The subminiature "pill" case featuring axial prongs for convenient mounting in strip-transmission-line or other circuits, represents a novel case style with unique advantages for the user. One of the prongs may be removed so that the case can be mounted upon tapped posts. This is especially convenient for mounting within miniature cavities as in microwave harmonic generators and cavity tuning applications.

Circle No. 239 on Subscriber Service Card

High-Voltage Capacitors

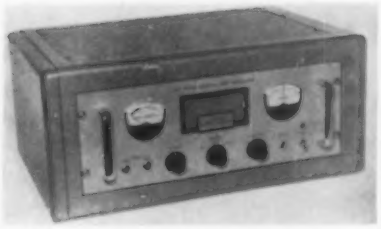
A line of encapsulated high-voltage miniature capacitors is being produced by Dearborn Electronic Laboratories, Inc. Designated the EF Series, these miniaturized units reportedly feature all the electrical characteristics of glass

tubulars without any of the accompanying inherent mechanical weaknesses. EF capacitors also have the same environmental characteristics as the larger CP-70 series capacitors, without their bulk and weight. Encapsulated in epoxy resin, they are impervious to shock, vibration, fungus and corrosion —as well as vacuum and/or pressure effects. They exceed requirements of MIL-C-25C.

Circle No. 240 on Subscriber Service Card

VLF Timing Receiver

A solid-state VLF timing receiver and correlator, offering front panel selection of the major VLF standard frequency stations, is available from Interstate Electronics Corp. The receiver, IEC Model 400, may be used, through front panel selection, at 16, 18, or 20 kc for reception of stations GBR, Rugby, England; NBA, Balboa, Canal



Zone; and WWVL, Sunset, Colo. The signal selected is automatically correlated with a signal derived from a local standard by means of the internal regenerative divider circuitry, giving an output of approximately one cycle each fifty seconds for a one part in one million frequency difference.

Circle No. 241 on Subscriber Service Card

Crucible Pot Furnace

An electric crucible pot furnace with atmosphere retort and forced-air cooling pit has been added to the line of equipment for production of semiconductors, solid-state and other electronic devices of Lindberg Engineering Co. This Type RDPC-77 Lindberg Furnace is rated at 2250°F (1232°C) maximum chamber temperature. Atmosphere retort with a clear working area of 4.5-in.-diameter by 6.5-in.-deep can be used to 2150°F. Rapid cooling of the retort is obtainable with a non-insulated forced-air cooling pit.

Circle No. 242 on Subscriber Service Card

200K Ohm Micropot

Borg Equipment Division, Amphenol-Borg Electronics Corp. is marketing a series of single-turn micropot potentiometers with a standard resistance range of from 100 ohms to 200,000 ohms. The resistance element is wirewound, featuring certified resistance alloys wound on thermosetting cards. Maximum power rating is 6 watts at 40°C. Gangable up to 8 units on a common shaft, the 2490 is designed to

withstand the higher temperature ranges up to 125°C. Housings and mounts are aluminum for maximum heat dissipation. Servo, bushing or tapped-hole mounts are available.

Circle No. 243 on Subscriber Service Card

new literature

EPOXY RESINS—Significant data on high-temperature properties of Oxiron epoxy resins and on the potential of these materials in laminate applications are reported in a technical bulletin published by the Epoxy Department of Food Machinery and Chemical Corp. The six-page bulletin, which covers findings from the latest studies of FMC's eposidized polyolefins, presents information on promising Oxiron resin uses in wet lay-up, prepreg, and printed circuitry laminate applications. Various Oxiron curing systems that have been found to give materials excellent high-temperature properties are also discussed.

Circle No. 200 on Subscriber Service Card

INSULATIVE SILICONES—An 8-page publication "Silicones for Electrical Insulation," is available from the Silicone Products Department of General Electric. Designated CDS-288, the publication is complete with more than 20 photographs and charts providing valuable data and examples of silicones in use in a wide variety of electrical and electronic application. Included are sections on silicone varnishes for impregnating and protective coatings, clear and opaque potting and encapsulating materials, pressure sensitive adhesives, dielectric fluids, dielectric greases, wire and cable insulation and combination constructions of silicones with other materials.

Circle No. 201 on Subscriber Service Card

LIMITED WAR—Planning Research Corp. has released a 24-page pamphlet on the role of planning and analysis in meeting the challenge of limited war. The pamphlet outlines representative problem areas in the following broad categories: transportation and supply; surveillance and reconnaissance; communications and data processing; weapons and weapons systems; air defense; special warfare; and economics of limited warfare. A resume of PRC experience, including some typical projects, in problems of limited war also is included.

Circle No. 202 on Subscriber Service Card

GLASS BONDED MICA—Electronic Mechanics, Inc. has published literature detailing new information on MYKROY glass-bonded mica as a high frequency insulator. The literature presents the data assembled in extensive tests on MYKROY 750 and MYKROY 1100, which conform to MIL-I-10A-L443 and MIL-I-10A-L442 respectively. The tests established the two grades as excellent low loss insulators at high frequencies.

Circle No. 203 on Subscriber Service Card

names in the news

BOGGS

TYSON

SMITH

MUSHRUSH

BREITWIESER

Dr. Samuel Koslov: Appointed assistant head of the Department of Physics and Space Sciences at Vitro Laboratories, West Orange, N.J. Prior to joining Vitro, Dr. Koslov was associate professor of physics at Stevens Institute of Technology.

D. C. Wolford: Formerly with Westinghouse Electric International Co., joins Temco International Corp., Washington, D. C., as director of technical operations.

Gail E. Boggs: Promoted to director of research and development, Page Communications Engineers, Inc., Washington, D.C. Before joining Page, a subsidiary of Northrop Corp., Boggs was head of the Time-Division Multiplex Section in the Department of Defense.

R. G. Fisher and **I. H. Moore:** Named project managers for the *Dyna-Soar* and Boeing 707 aircraft electric system programs at Westinghouse Aerospace Electrical Dept., Lima, Ohio.

Bert Fleming: Named senior manufacturing engineer, electro-mechanical devices, in the Military Electronics Division of Daystrom, Inc., Archbald, Pa. **Donald S. Taylor** joins the division as development engineer.

Dr. Grant S. Bennett: Appointed chief scientist-acoustics, Chrysler Corp.'s Missile Division, Detroit, to direct the division's expanding activities in underwater acoustics research and development. Prior to joining Chrysler, Bennett was supervisory physicist at Bendix Corp.'s research laboratories.

William F. Parker: Named vice president, program management, North American Aviation's Space and Information Systems Division, Downey, Calif. Parker also heads the division's *Saturn S-II* booster proposal effort. **Dr. Clifford E. Weber** named director of fuels and materials at Atomics International Division of NAA; **W. F. Snelling** appointed executive vice president, **Gary Stroh,** manufacturing vice president, at NAA's Los Angeles division.

Dr. Andrew Herczog: Promoted to senior research associate in electronics, Corning Glass Works, Corning, N. Y.

John W. Boone: Former vice president of Radiation, Inc., elected to board of directors, Airpax Electronics, Inc., Ft. Lauderdale, Fla.

Owen A. Tyson: Appointed director of newly-formed Microwave Electronics activity in Quantatron's Microwave Laboratories, Santa Monica, Calif., where he will be engaged in development and engineering design of solid-state devices for microwave applications. **E. O. Bowers,** associated with Tyson in this work, is responsible for applications engineering in parametric amplifiers and other solid-state devices.

John Ohman: Former head of Physics Laboratory, Melpar's Applied Science Division, appointed head, Physical Sciences, Bay State Electronics Corp., Boston.

Dr. Maurice L. Torti: Promoted to director of metallurgical research, Metals Division, National Research Corp., Cambridge, Mass. **Richard W. Douglass,** previously with Battelle Memorial Institute, joins NRC as metallurgist.

Arnold H. Smith: Named director of quality assurance, Military Systems/Stavid Division, Lockheed Electronics Co., Plainfield, N.J. Smith was formerly supervisor for reliability technical support with The Martin Co.

Roy S. Mushrush, Jr.: Formerly in Heavy Military Electronics Dept., appointed manager of General Electric's new Engineering Operation in the Defense Systems Dept. **Robert G. Henry** named manager of the Marketing Operation, succeeding **Warner R. Sinback,** who is now manager of the Information and Control Systems Product Section, DSD.

Dr. Charles J. Breitwieser: Co-founder and director of Cubic Corp., San Diego, elected executive vice president and general manager.

Dr. F. Joachim Weyl: Appointed Deputy Chief and Chief Scientist of the Office of Naval Research, Washington, D. C., replacing **Dr. Thomas J. Killian,** who has resigned to accept a position in private industry.

Philip M. Prophett: Named manager of Base Activation at General Dynamics/Astronautics, San Diego, Calif., where he will be responsible for setting up the complete weapon system for the Strategic Air Command's operational *Atlas* missile. Prophett succeeds **A. P. Higgins,** who became vice president of The Hayes Corp., Birmingham, Ala.

Dr. Harold H. Sheldon: Appointed director of research and development and a member of the board of directors, Bristol Dynamics, Inc., Brooklyn, N.Y.

Dr. Charles W. Walton: Promoted to vice president for research, Minnesota Mining & Manufacturing Co., St. Paul.

Drs. Robert L. Hubbard and **Edgar R. Terry:** Join the Operations Evaluation Group of Massachusetts Institute of Technology as members of the Washington, D.C., research staff. OEG conducts operations analysis for the Office of the Chief of Naval Operations.

Dr. Kazuo A. Yamakawa: Joins Electro-Optical Systems, Inc., Pasadena, Calif., as head of the Materials Research Dept. of the Quantum Physics Division. Prior to joining EOS, Dr. Yamakawa was with Hughes Research Laboratories.

James F. McGee: Appointed chief of the Systems Test and Operation Section, Jet Propulsion Laboratory, California Institute of Technology, Pasadena. McGee replaces **Dr. Norman F. Jacobson,** named chief of the Program Engineering Section.

H. Eugene Crow Jr.: Formerly with Dage Div., Thompson Ramo Wooldridge, Inc., named manager of television systems for Cohu Electronics, Inc., Kin Tel Division, San Diego, Calif.

Harold D. Kube: Elected to Frederick Research Corp.'s board of directors, Wheaton, Md. Kube also is treasurer of Jansky & Bailey, a division of Atlantic Research Corp., Alexandria, Va.

Robert J. Veale: Former senior staff engineer, appointed manager of radar applications engineering at Hughes Aircraft ground systems group, Fullerton, Calif.

contracts

NASA

$128,000—**Electronics Communications, Inc.**, St. Petersburg, Fla., for research and development and design of package for *Saturn* flight control computer.

Astro-Electronics Div. of Radio Corp. of America, Princeton, N.J., from Marshall SFC, for development of a payload capsule for flight-testing electric propulsion engines. No amount disclosed.

MISCELLANEOUS

$225,000—**Networks Electronic Corp.**, Chatsworth, Calif., from **ACF Industries, Inc.**, Paramus, N.J., for highly sensitive, infrared dewar detectors.

Radio Corp. of America, New York City, from **Lockheed Missile and Space Co.**, for construction and installation of an automatic programer and test system (APATS) for monitoring and testing of satellites in an environmental chamber.

NAVY

$900,000—**Atlantic Research Corp.**, Alexandria, Va., from ONR, for production of *Arcas* sounding rocket.

$125,000—**Varo, Inc.**, Garland, Tex., for production of missile-borne hot-gas turbogenerator power units for *Sidewinder* missiles.

$78,099—**Vickers, Inc.**, Waterbury, Conn., for solid-propellant starting system.

Systems Div., LFE Electronics, a group of **Laboratory for Electronics, Inc.**, Boston, for production of analog computer modules for use in *Polaris* submarines. No amount disclosed.

ARMY

$9,435,032—**Western Electric Co., Inc.**, New York City, for 12 partial sets of *Nike-Hercules* ground equipment.

$2,900,000—**Fairchild Stratos Corp.**, Hagerstown, Md., for continued work on *AN/USD-5* surveillance drone system.

$1,040,131—**Raytheon Co.**, Waltham, Mass., for concurrent repair parts, *Hawk* missile system. (2 contracts)

$982,458—**Eclipse-Pioneer Div., Bendix Corp.**, Teterboro, N.J., for special test and checkout equipment for *Pershing* guidance and control assembly.

$605,800—**PRD Electronics, Inc.**, Brooklyn, N.Y., for design and construction of a prototype microwave calibration test set 200 to 40 kmc, and 8 additional sets.

$343,560—**Western Electric Co.**, New York City, for research and development of the *Nike-Zeus (Nike II)* guided missile system.

$183,000—**RCA's Surface Communications Div., Defense Electronic Products**, Camden, N.J., for study to develop a maintenance and logistics program for micromodule equipment.

$98,000—**Martin Co.**, Orlando, Fla., for preliminary models for evaluation and test purposes of private radio-telephone system (RACEP) capable of handling scores of subscribers over a single-frequency channel virtually interference-free.

$90,000—**Arthur D. Little, Inc.**, Cambridge, Mass., for development of pyrolytic refractory materials for solid-fuel rocket motor application.

AIR FORCE

$3,343,395—**Douglas Aircraft Co.**, Santa Monica, Calif., for modernization of facilities for use in work on *Skybolt* missile.

$2,300,000—**General Dynamics Corp., Astronautics Div.**, for maintenance on end items and components of *SM-65 Atlas* airframe and associated ground equipment; $1,081,000 for *Atlas* system integration and in-service engineering.

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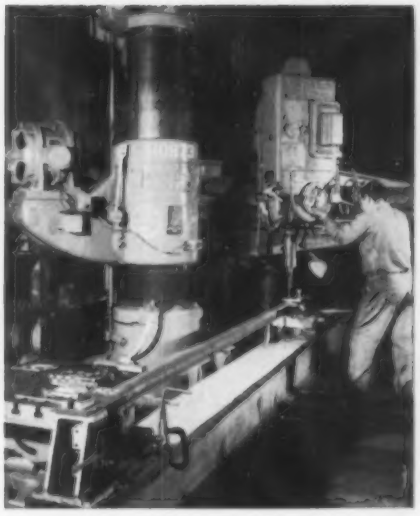
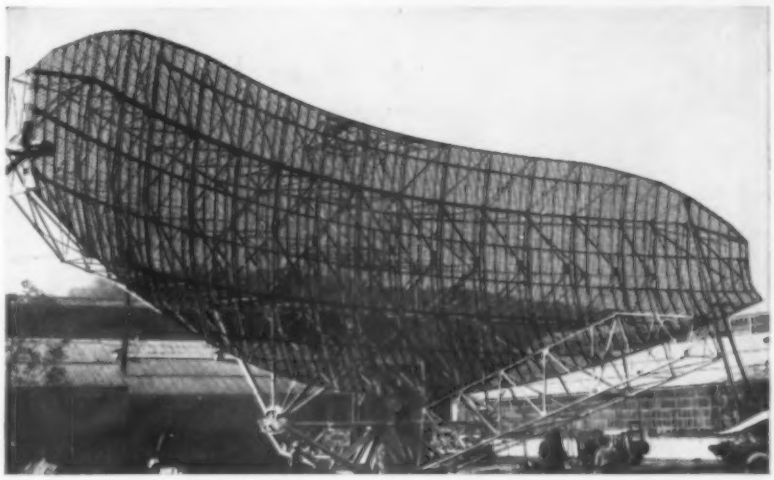
SKILL HERE MEANS ACCURACY HERE





U.S.A.F.'s FPS-35 Radar Antenna, built for Sperry Gyroscope Co.

Blaw-Knox skill in fabricating intricate structures to close tolerances makes possible even greater accuracy in the operation of radar antennas, tracking antennas or radio telescopes. Highly developed manual skills and skillful operation of machine tools assure better fit in these large, but extremely precise instruments.

It is the master-craftsman skills at Blaw-Knox, plus Blaw-Knox's unique shop facilities and years of fabricating experience, that produce close-tolerance instruments. And Blaw-Knox engineering skills assure the right design to make the best use of those facilities and that experience.

Blaw-Knox designs and produces antennas to close tolerances with minimum deflections at reasonable cost — fabricates in steel, special alloys and aluminum — designs to your needs or builds to your specifications. Complete research, engineering, testing and fabricating facilities are at your disposal. Write or phone for immediate attention. Blaw-Knox Company, Pittsburgh 38, Pennsylvania. Phone STerling 1-2700.

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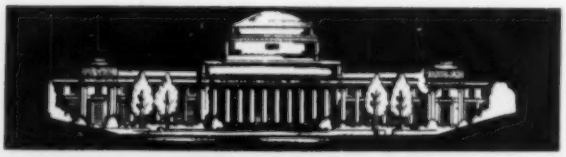

The Laboratory's staff of over 1000 under the direction of Dr. C. Stark Draper is engaged in the conception and perfection of completely automatic control systems for the flight and guidance of missiles and space vehicles. Its achievements include the Navy Mark 14 Gunsight, the Air Force A-1 Gunsight, Hermetic Integrating Gyros (HIG), and the Ship Inertial Navigation System (SINS). The Laboratory developed basic theory, components and systems for the Air Force THOR and, later, the TITAN missile.
The Laboratory also developed the Navy's POLARIS guidance system. Studies for NASA are currently being carried out.

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. . . contracts

$1,750,000—Hurletron, Inc., Wheaton Engineering Div., Wheaton, Ill., from **RCA,** for electronic timing devices for *Atlas* missile; **$2,250,000** from **Hallamore Electronics Co.,** for timing devices for *Atlas*.

$882,600—GE's Missile and Space Vehicle Dept., Philadelphia, for development of aerospace test capsule for testing a 50-watt fuel cell battery.

$423,967—RCA's Aerospace Communications and Control Div., Defense Electronic Products, Burlington, Mass., from Rome Air Development Center, for design and study of feasibility of a simulation testing facility under the DOD Radio Frequency Compatibility Program.

$379,700—Boeing Co., Seattle, for investigation of propellant system optimization.

$287,000—Institute of Science & Technology of Univ. of Michigan, Ann Arbor, for investigation of ways of protecting aircraft and space vehicles from destruction by hostile missiles.

$248,000—United Aircraft Corp., Research Laboratories, E. Hartford, Conn., from AFSC, for design development and testing of an ion engine.

$200,000—Martin Co., Denver, for direct support/real property installed equipment operational spare parts, special tooling and test equipment for *Titan II* bases.

$173,608—Missiles Systems Corp., N. Hollywood, Calif., for spare parts for after launcher harness and forward missile launcher.

$100,000—United Aircraft Corp., from OAR, for continued basic research in the physics of accelerating the particles in an ion beam under neutral conditions.

$93,694—Lockheed Electronic Co.'s Military Systems Stavid Div., Plainfield, N.J., for procurement of 20 radar systems (X-band radar augmenters) for installation in supersonic missile targets.

$76,000—Astronautics Div., Chance Vought Corp., Dallas, for investigation of requirements for a system to detect or predict an emergency situation in a spacecraft and react in thousandths of a second to initiate escape and save the astronaut.

REQUESTS

The National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md., has issued a request for Proposal No. GS-3646 for the Design and Construction of a 12-ft. x 15-ft. Space Environmental Chamber Facility which shall be a totally integrated facility housed in a section of the Payload Test Facility Bldg. 7, Goddard Space Flight Center, Greenbelt, Md.

The space environment chamber shall provide capabilities for recreating or simulating the effects of the thermal-vacuum environments and evaluation of spacecraft, spacecraft subsystems, and associated testing equipment. The facility shall permit test items to be mounted within a vessel 21 feet in diameter by 15 feet high and subjected to environmental exposure by (A) radiant heating and cooling the test item in a high vacuum by means of a thermal conditioning wall—(B) radiant heating and cooling the test item in high vacuum by means of a solar simulator and a heat sink at liquid nitrogen temperatures. Proposals are due to be received at the NASA Procurement Office, Goddard Space Flight Center, Greenbelt, Md., by August 7, 1961.

The following firms have been invited to participate: NRC Equipment Corp., Attn: John V. E. Hansen, Newton 61, Mass.—F. J. Stokes Corp., Attn: David E. Stokes, Philadelphia 20, Pa.—Adache Associates, Inc., Attn: William J. Alvarez, Cleveland 4, Ohio—Flui Dyne Engineering Corp., Attn: J. Leonard Frame, Minneapolis, Minn.—Wyle Manufacturing Corp., Attn: J. A. Sneller, El Segundo, Calif.—Webber Mfg. Co., Inc., P. O. Box 217, Attn: Robert C. Webber,

Indianapolis 6, Ind.—Alpha Electric Refrig. Co., Attn: Charles E. Earl, Detroit 3, Mich.—International Radiant Corp., Attn: Karl D. Klein, New York 55, N.Y.—Westinghouse Electric Corp., Attn: William Duncan, Washington 6, D.C.—The Elec. Totpack Co., Inc., Attn: Arnold S. Mann, Philadelphia 35, Pa.—Conrad, Inc., Attn: Charles F. Conrad, Holland, Mich.—Consolidated Vacuum Corp., Attn: Lionel B. Buarcks, Arlington 1, Va.—Tenney Engineering, Inc., Att: Monroe Seligman, Union, N.J.—Catalytic Construction Co., Attn: Victor C. Quakenbush, Philadelphia 2, Pa.—Bethlehem Foundry & Machine Co., Attn: Bernard Friedman, Bethlehem, Pa.—Nooter Corp., P. O. Box 451, Attn: Mr. Robert H. Harper, St. Louis 66, Mo.—American Optical Co., Attn: Joseph Kalla, Pittsburgh 6, Pa.—Aerojet-General Corp., Aetron Div., Attn: Bryant Moore, Covina, Calif.—American-Marietta Co., Guardite Co. Div., P. O. Box 188, Attn: John M. Baer, Wheeling, Ill.—United Engineering & Construction Co., Philadephia, Pa.—Minneapolis-Honeywell Regulator Co., Duarte Development Laboratory, Duarte, Calif.—Radio Corp. of America, Attn: F. C. Weisback, Lancaster, Pa.—Varion Associates, Palo Alto, Calif.—High Vacuum Equip. Corp., Attn: William E. Sprague, Hingham, Mass.—Pittsburgh-Des Moines Steel Co., P. O. Box 3459, Attn: C. B. Ford, Baltimore 26, Md.—Chicago Bridge & Iron Co., Attn: S. L. Luca, Philadelphia 3, Pa.

NASA suggests that small business firms or others interested in subcontracting opportunities on this procurement make direct contact with the above firms.

* * * *

The National Aeronautics and Space Administration Procurement & Contracts Office, George C. Marshall Space Flight Center, Huntsville, Ala., has issued a request for Proposal No. TP 2-83018 to Design and Fabricate a Telemetry Pre-Detection Recording System which will receive telemetry information from a vehicle in space flight and convert the RF signal as received to a frequency that can be recorded. Play-back of signal will be converted back to an intermediate frequency suitable for insertion into the IF amplifier of the receiver and then demodulated by the receiver.

The work under this request shall be performed in three phases: Phase I: Preliminary Design and Selection of Commercially Available Components; Phase II: Procurement and Modification of Components and Finalizing Design and Fabrication of other required components; Phase III: Assembly and Checkout of Completed System and System Compatibility Test at the Center.

Proposals are due to be received at NASA P&C Office, George C. Marshall Space Flight Center by 7 Aug. 61.

The following firms have been invited to participate: Motorola, Inc., 1120 Connecticut Ave., Washington 6, D.C., Suite 1120—Lockheed Electronics Co., Highway 22, Plainfield, N.J.—Molectronics, 6344 Arizona Circle, Los Angeles 45, Calif.—Radiation, Inc., Melbourne, Fla.—A C P Electronics Div., Riverdale, Md.—Servomechanisms, 12500 Aviation Blvd., Hawthorne, Calif.—Ford Instrument Co., 31-10 Thomson Ave., Long Island City 1, N.Y.—Cook Electric Nuckedyne Div., 3412 River Road., Franklin Park, Ill.—Vought Astronautics Div., Chance Vought Corp., P. O. Box 5907, Dallas, Tex.—Telecomputing Corp., Electronic Systems Div., 2700 Memorial Parkway, Huntsville, Ala.—RCA Astro Electronics Div., Defense Electronic Products, Princeton, N.J.—The Bendix Corp., Bendix Pacific Div., 11600 Sherman Way, North Hollywood, Calif.—Ecra Inc., Decatur, Ga.—Daystrom, Inc., 2917 Sanderson Rd., Knoxville, Tenn.—Texas Instruments, Inc., 6000 Lemmon Ave., Dallas 9, Tex.—Chrysler Corp., Missile Div., 1312 Meridian St., North Huntsville, Ala.—and Data Control Systems, East Liberty St., Danbury, Conn.

NASA suggests that small business firms and others interested in subcontracting opportunities on this procurement make direct contact with the above firms.

when and where

AUGUST

Space Age Astronomy, symposium sponsored by Douglas Aircraft Co., Cal-Tech, Pasadena, Aug. 7-9.

American Rocket Society/Stanford University, Guidance, Control and Navigation Conference, Stanford University, Palo Alto, Calif., (Some sessions classified), Aug. 7-9.

Society of Photographic Instrumentation Engineers, Sixth Annual Technical Symposium, Ambassador Hotel, Los Angeles, Aug. 7-11.

Fourth Annual Institute on Missile Technology, sponsored by University of Connecticut and Air Force Air Research and Development Command, University of Connecticut, Storrs, Aug. 7-18.

Survival in the Nuclear Age-Executive Management Seminar, Pennsylvania State University, University Park, Aug. 13-18.

International Astronomical Union, 11th General Assembly, Pasadena, Calif. Aug. 15-24.

American Rocket Society International Conference on Hypersonics, Compton Lecture Hall, Massachusetts Institute of Technology, Cambridge, Aug. 16-18.

National Naval Aviation Meeting, Institute of the Aerospace Sciences, San Diego, Calif., Aug. 19-24.

Welded Electronic Packaging Association Symposium, Lockheed Missiles and Space Co.'s Palo Alto Research Facility, Calif., Aug. 21.

National Academy of Sciences 10th Pacific Science Congress, University of Hawaii, Honolulu, Aug. 21-Sept. 8.

Western Electronics Show and Convention (WESCON), Cow Palace, San Francisco, Aug. 22-25.

American Rocket Society Fourth Biennial Gas Dynamics Symposium, cosponsored with Northwestern University Technological Institute, Evanston, Ill., Aug. 23-25.

American Institute of Electrical Engineers, Pacific General Meeting, Salt Lake City, Aug. 23-25.

AFOSR Sixth International Conference on Coordination Chemistry, sponsored with American Chemical Society, Wayne State University, Detroit, Aug. 27-Sept. 1.

American Society of Mechanical Engineers 1961 West Coast Conference of Applied Mechanics, University of Washington, Seattle, Aug. 28-30.

ASME and AIChE International Heat Transfer Conference, New Developments in Theory and Practice, University of Colorado, Boulder, Aug. 28-Sept. 1.

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editorial . . .

The Great Tushino Stampede

THIS WILL NOT be a very popular view but it must be said. We find ourselves thoroughly disgusted with the completely predictable and Pavlovian response to the Tushino airshow of the U.S. Air Force, some members of Congress and certain editorial writers.

It is a callous "gimme more money" scramble which casts considerable doubt on the responsibility of some of our military and Congressional leaders.

We cannot buy the picture of a thoroughly startled Air Force finding itself obsoleted by the appearance of a few Russian aircraft. Don't believe for a minute that our intelligence has been that bad. There have been too many hypocrites on public display since Tushino.

Take the statement of Sen. Goldwater, who holds the rank of general in the Air Force reserve. Apparently chilled by the appearance of the Russian bombers, he tells us the U.S. has "no fighter force worthy of the name."

Somebody has voted a lot of money for such aircraft as the McDonnell F-101 and Convair F-102 and we don't recall any previous statements from Sen. Goldwater to the effect that this money was wasted.

The nation's defense spending should be based on a reasoned assessment of what is necessary to do the job, not on hysterical or hypocritical "me-tooism."

We don't see why the "revelation" that the Soviet Union now has fighters armed with air-to-air missiles which are capable of shooting down our bombers becomes a strong argument for buying more obsolescing B-52's. It would seem to us to be a stronger argument for buying missiles which those interceptors cannot shoot down. Or perhaps for funding that long-endurance aircraft equipped with stand-off air-to-surface missiles to which Secretary McNamara keeps referring.

Or it might seem that the appearance of Russian bombers at Tushino would support a strong case for revival of the F-108, salvage of the sharply-cut *Bomarc B* program, or purchase of additional *Nike-Hercules*. Yet, with the exception of a brief lament for the F-108, there has been no loud outcry for any of this.

Why not? Why has all the shouting been for additional B-52 procurement and a step-up in the B-70 program? Could it be because Congress already has provided $448 million in new obligational authority for long-range bombers which Defense Secretary McNamara indicated he did not intend to use? Perhaps we are too cynical.

But let it be made clear. Very little was shown at the airshow in Moscow which we did not know about or could not have anticipated. To use the Soviet fly-over as a lever for unwise spending is irresponsibility of the worst kind.

WE ARE ENGAGED in a cold war with the Soviet Union—which implies economic as well as military competition. If we allow ourselves to be stampeded into spending funds unwisely, the Russians score a decisive if not widely acknowledged victory.

The proper mix of aircraft and missiles for our defensive and offensive strength is determined after careful assessment. It should be changed as required to meet shifting tactical and strategic needs. To do it in a deliberately created atmosphere of hysteria in reaction to the Russian display will ill serve the nation.

Diversion of our attention at this time from missiles and space vehicles to manned aircraft could be a deliberate tactic on the part of the wily Mr. Khrushchev. Let's not jump blindly at the bait.

We realize we are leaving ourselves open to a charge of special pleading, since our basic interest lies in the field of missiles and space.

We would like, therefore, to point out that a buildup of manned aircraft would be directly to the financial advantage of firms in the missile/space industry which also are involved in aircraft production. Since we carry advertising from those firms, it presumably might be to our benefit to keep our thoughts to ourselves.

We, as a magazine, cannot stomach that type of thinking. It should be no more palatable to the industry as a whole or to the nation. If the Tushino show has demonstrated an unexpected need for more manned bombers—and we have yet to see a reasoned argument proving this—then they should be purchased.

But, as *Time* magazine points out: "The best answer to Russia's new planes may not be a better plane, but a new rocket or more *Polaris* submarines."

Let's decide calmly and then act, not react.

William J. Coughlin

Left: Test-firing of large, flight-weight solid propellant rockets at UTC Development Center is important phase of multi-million pound thrust booster development program.

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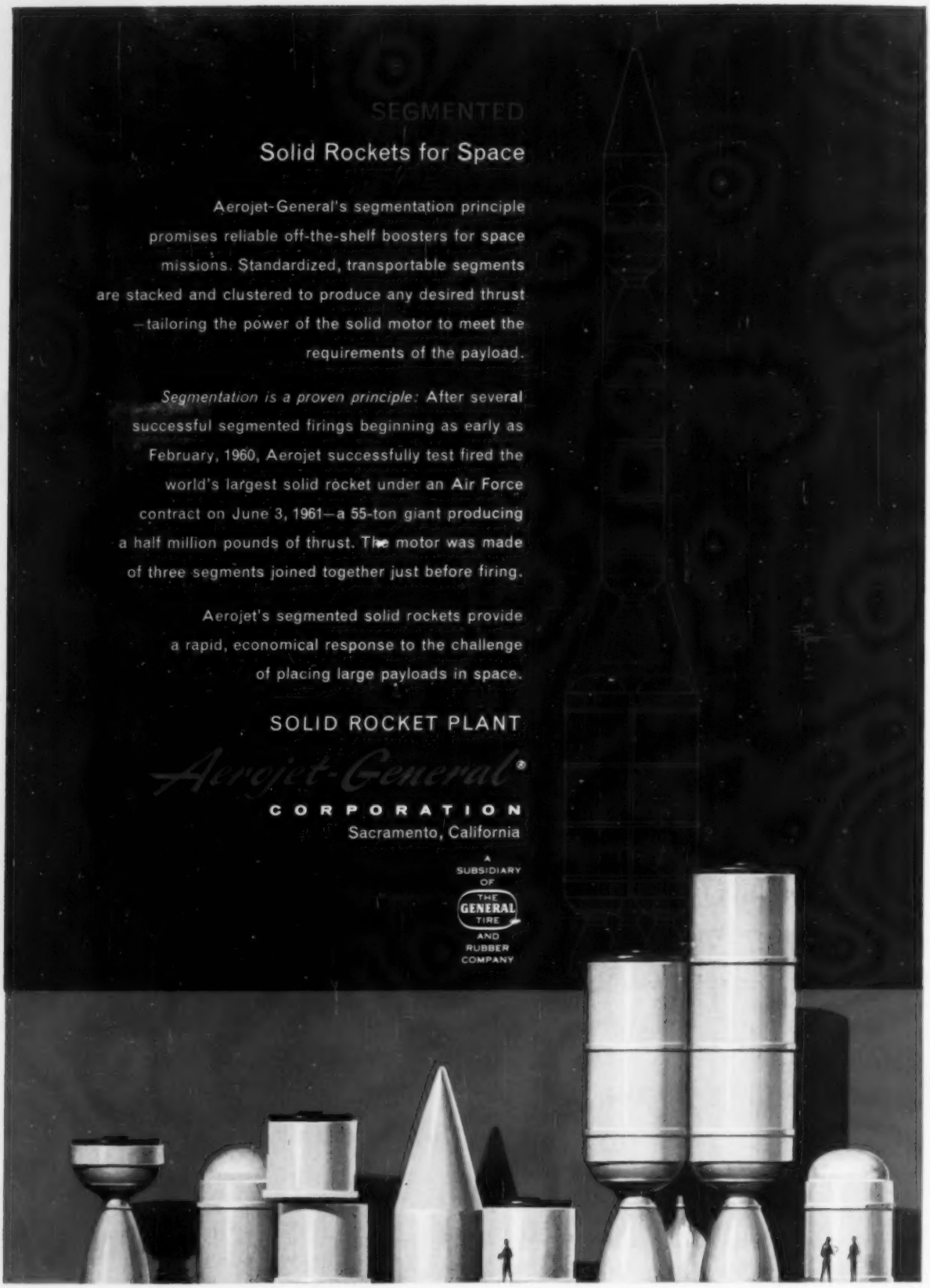
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